Pete Wilson,
Governor
State of
California

CALIFORNIA ENERGY COMMISSION

Home Energy Manual

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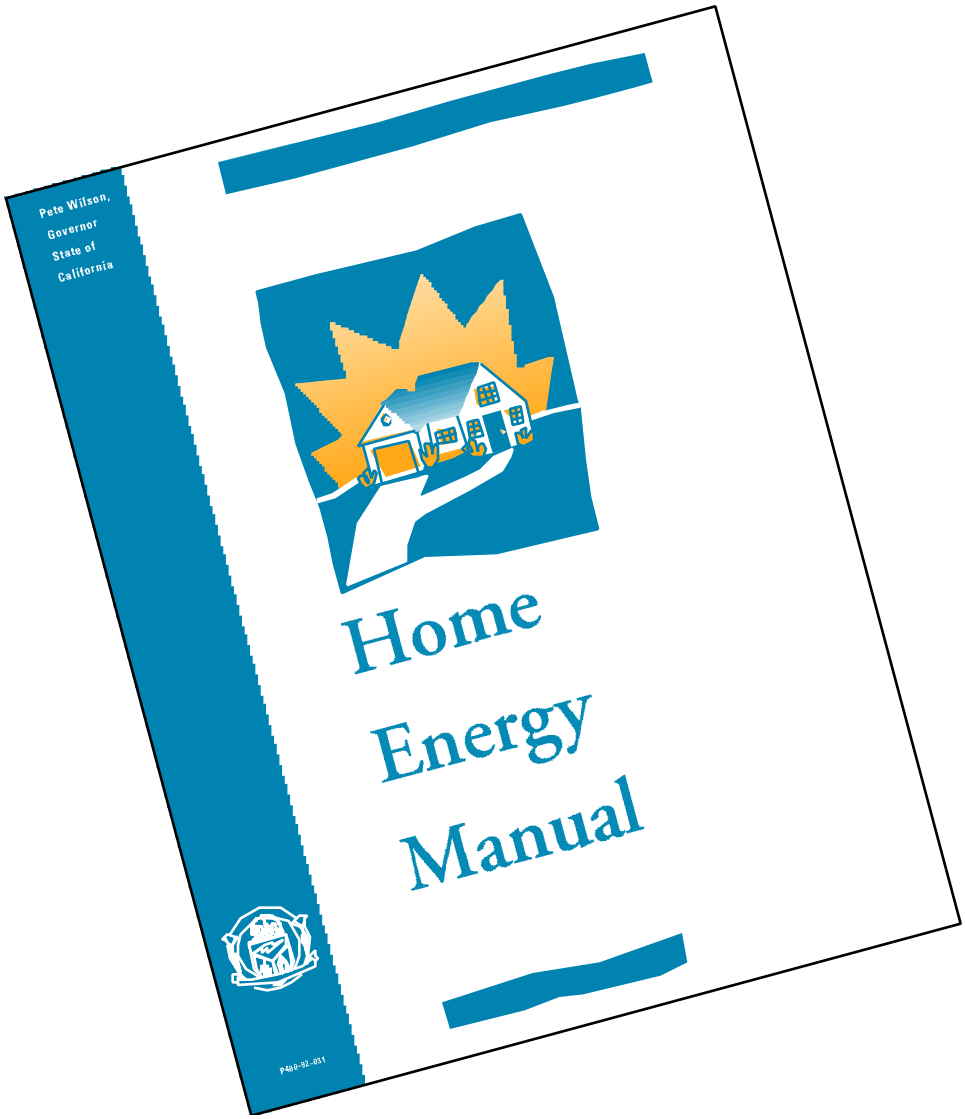

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HELP YOURSELF SAVE MONEY— HELP CALIFORNIA SAVE ENERGY

A big part of easy living is having a comfortable and affordable home. This is why one of the best investment decisions you can make is buying an energy-efficient home.

This manual will help you enjoy a more comfortable home during every season of the year while keeping energy bills to a minimum. The California Energy Commission has prepared this guide to explain the energy-saving features of your home. These valuable features are the result of a statewide energy policy designed to make new California homes among the most energy efficient in the nation.

There are several practices that you can adopt to further reduce the energy use and its associated cost in your household. Cutting down on unnecessary energy use is one of the easiest ways to put extra dollars into your pocket. Encourage everyone in the household to save energy.

This manual shows you how to develop smart energy habits that will quickly lead to energy and dollar savings. When you incorporate these habits into your daily life you can also make your home more comfortable.

Your total home energy bill depends on the cost of energy and the amount you consume. Your energy-efficient home will keep your actual bills lower than those of less efficient homes. Even when energy prices increase, you'll still pay less for energy than you would have without the energy-efficient features built into your home.

A CONSTANT SOURCE OF USEFUL INFORMATION

Please take time to read through this manual and, when applicable, follow the simple instructions. This reference manual is designed to be a quick reading source of energy and dollar saving ideas that can benefit you today and in the future. The manual is organized into the following chapters:

Chapter 1 explains the energy-efficient features in your house and offers easy-to-follow use and care instructions to ensure optimal performance.

Chapter 2 includes a quick reference maintenance checklist and suggestions for easy, no- or low-cost, do-it-yourself ways to increase your energy savings beyond the savings assured by your home's built-in energy-efficient features.

Chapter 3 discusses major opportunities for making energy-saving improvements to your home, both indoors and out. The discussion includes decision points with energy-saving ideas for the present and the future. A home that saves energy costs less to live in and is worth more. You will learn why efficiency improvements can be among the best investment choices you can make.

Chapter 4 explains the three different methods that distinguish California homes as being "energy efficient." Energy use depends partly upon weather conditions, and Californians live in a wide range of climates. While it will cost more to heat a home in Truckee than in San Diego, both cost 75 percent less to heat and cool than homes built prior to establishment of energy efficiency standards.

Chapter 5 provides useful resource information and telephone numbers. This section also offers "Helpful Terms" to help you understand terms used throughout the manual.

CHAPTER 1

ENERGY-SAVING FEATURES OF YOUR NEW HOME

Your new home has been designed, constructed and equipped for energy efficiency. This section covers *Mandatory Measures* — the energy-efficient features and devices required in all new California homes. It also explains other "variable" measures that may have been installed in your home to comply with an energy budget allowed by the state energy standards for new homes. Meeting the overall energy budget demonstrates that you have an energy-efficient home.

It's a good idea to identify the location and best operation for each energy-efficient feature in your home. As you read through this chapter, refer to Figure 1 to help locate each mandatory feature. Also refer to Chapter 4 and the enclosed CF-1R form for an explanation of energy compliance, and to determine which features have been included in your home.

This chapter also offers easy-to-follow instructions on use and care of energy features and equipment to ensure optimal performance, durability and realization of their predicted energy savings.

Many of the energy-efficient measures, such as insulation and certified windows and doors, are "built in" your home. Saving energy requires your attention to good energy use habits throughout your home, throughout the year. These habits include simple steps such as turning off unnecessary lights and appliances and shading windows to avoid heat gain from the sun. Energy consuming behaviors have a significant effect on whether you receive the benefits these features offer, such as lower home operating costs, increased comfort, and enhanced resale value of your home.

INSULATION: YOUR YEAR'ROUND ENERGY SAVER

Your new home's insulation ensures that heating and cooling dollars do not escape through your ceilings, walls and floors.

Insulation slows the passage of heat both into and out of your home. In the summer and winter, drafty chills and room temperatures that are too hot one minute, too cold the next might have caused discomfort in the past. Insulation helps your home maintain a uniform temperature throughout, making your home more comfortable. Insulation also acts as a sound absorber — another reason why your energy-efficient house is a more comfortable and relaxing place to live.

All living areas (heated areas) are separated from unheated areas with insulation. This helps keep walls, ceilings and floors warmer in winter and cooler in summer. During the warmer months, insulation helps your house to remain comfortable at higher thermostat settings.

INSULATION IS YOUR HOME'S THERMAL BLANKET

Insulating materials do not heat or cool, rather they prevent the flow of heat into or out of your house. The effectiveness of insulation is measured in terms of thermal resistance or insulating value, called "R-value," which indicates "resistance" to winter heat loss and summer heat gain. The

ACTION:

Check your insulation to be sure it is installed to the proper level (see CF-1R) and that under floor insulation is securely fastened. Check attic insulation for even distribution and to ensure the attic access is insulated.

BARRIERS TO MOISTURE WITHIN YOUR HOME

The warm air inside your house contains water vapor (moisture). If this vapor passes into your home's insulation and then condenses, it can cause significant loss in the effectiveness of your insulation. In addition, if moisture becomes deposited in your home's structure, it can cause mold growth, peeling paint and eventual rotting of structural wood.

In California's cooler climate zones, continuous "vapor retarders" (vapor barriers) are required on the warm side — the lived-in side — of all exterior walls, on the floor of the unvented attic and on all floors above unvented crawl spaces. This location prevents moisture in the warm indoor air from reaching the insulation. If your home is in an area where the climate is predominantly hot, such moisture control may not be necessary and the vapor retarder is generally omitted.

higher the R-value the greater the insulating power. The actual R-value of thermal insulation depends on the type of material from which it was made, its thickness and density.

Several basic forms of insulation are:

Blankets

Insulation is most commonly purchased in rolls (referred to as blankets) available in varying R-values. Blankets can be cut to the needed length and come in widths to fit snugly between rafters, joists and studs when installed. Rock wool and fiberglass blankets come in blankets and are used in finished and unfinished attics, heated and unheated crawl spaces, newly constructed exterior walls and floor/ceiling areas. Blankets can be purchased with or without attached vapor retarders, discussed in the box "Barriers to Moisture."

Batts

Batts are strips or blankets of rock wool or fiberglass insulation pre-cut to 4-foot or 8-foot lengths. Batts are between 15 and 23 inches wide and can be bought with or without a vapor barrier. Like blankets, batts are used for insulating unfinished attics, crawl spaces, newly constructed exterior walls and floor/ceiling areas. Proper installation requires batting to evenly fill the entire wall cavity.

Loose fill

Loose insulation is packaged in bags and can be poured or blown into place. Rock wool, fiberglass, cellulose, vermiculite and perlite can be purchased in this form. Loose fill is especially useful when trying to place insulation in hard-to-reach areas. Vapor retarders must be separately purchased and installed when using loose fill.

Rigid boards

Usually made of molded plastic or fiberglass, rigid boards are easily installed by gluing, nailing, or stapling to walls and studs. They provide thermal and acoustical insulation and often are used in vaulted or cathedral ceilings, over wall studs, on the exterior surface of the house and/or to insulate basement walls. Rigid board normally has an R-value of between R-3 and R-7 per-inch thickness.

CEILING, WALL AND FLOOR INSULATION

The insulating materials in your home comply with the "California Quality Standards for Insulating Material." This ensures that the insulation performs according to its stated R-value and meets minimum quality, health and safety standards. The insulation levels required to prevent heat leakage, as shown in Figure 1, include the following minimums:

Your ceilings must be insulated to R-19 but will probably be insulated to R-30 or higher.

If your home has framed walls, they must be insulated to a minimum of R-13. Depending on your location, your home may be insulated to R-19 or higher. If your walls are brick or concrete they do not have to be insulated with R-13 insulation, but they may have to meet other insulation requirements. Framed foundation walls of heated basements or heated crawl spaces must be insulated above the adjacent outside ground line with at least R-13 insulation.

Insulation prevents heat loss through the floor of your house. Your home has either a slab or raised floor. Check the CF-1R form to determine if your house includes slab edge insulation to comply with the standards. If it does, slab-edge insulation

must be installed to a minimum depth of 16 inches or the depth of the footing (see "Helpful Terms"), whichever is less. The depth is measured from the top of the insulation, as near the floor line as practical, to the bottom edge of the insulation. It is not required around the garage, between the house and porch, or between the garage and the house.

If your home has a raised wood floor, it must have insulation of at least R-13. If the raised floor is concrete, R-8 insulation is required.

WINDOWS

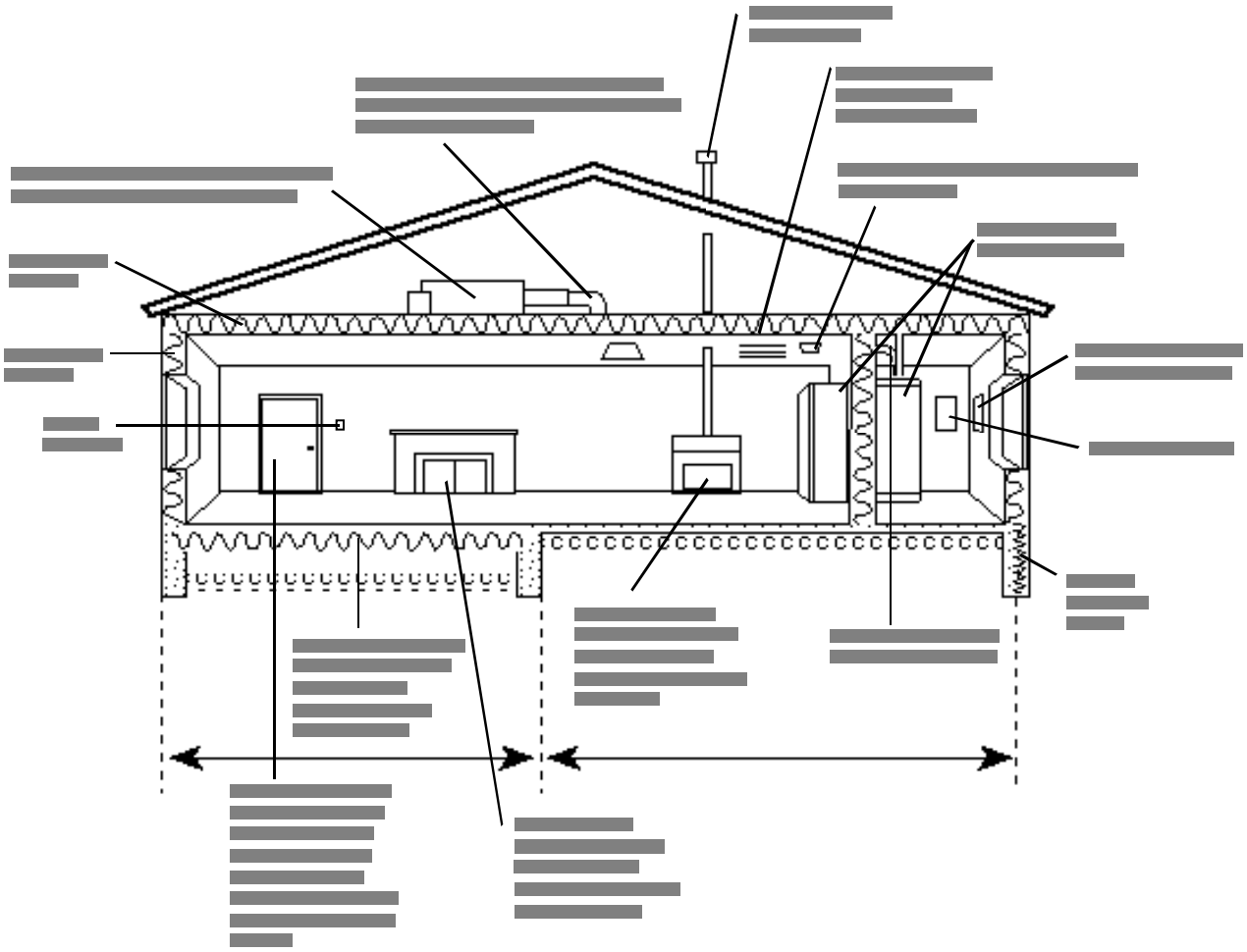
Windows, even when insulated and shaded, are one of the largest sources of heat loss and heat gain in your home. Because windows serve so many purposes in the home, the issue of energy efficiency in windows is frequently overlooked. Compared to walls, floors and ceilings, windows much more dramatically affect your home's heating and cooling needs, your comfort, and your utility bills.

Manufacturers are required to rate all windows placed in California homes. This rating ensures that such windows limit air leakage to allowable levels. Effective in 1993, all windows will require labels that include the U-value (see "Helpful Terms"). The U-value label, like the R-value for insulation, will help determine a window's efficiency should you need to replace any in the future.

Check the CF-1R form to find out what type of windows are installed in your house. Are they the same in each room or is there a higher-efficiency type on the south- and west-facing window?

The following information helps you understand the value of your windows in terms of the energy and dollar savings they offer, and will enable you to make an informed decision should you purchase new windows in the future.

Figure 1. Most Common Mandatory Measures



ACTION:

Be sure to draw blinds during the summer months. To keep your house as cool as possible, open blinds in relation to the position of the sun. Only open blinds on the sides of the house where the sun is not shining. During winter months, open the blinds on sunny exposures during good weather and close them at night and during cloudy periods.

SHADING DEVICES

Solar heat gain through your windows is desirable on cold winter days, but it can also result in larger cooling bills during the summer. The best way to reduce unwanted solar heat gain is to block the sun before it enters your home. Shading strategies for existing windows include exterior devices, such as solar screens and awnings, and interior methods like draperies, blinds and simple roller shades.

- Exterior shades prevent up to 95 percent of the sun's heat from reaching your home's interior. Modest fixed overhangs are effective in blocking direct sunlight from entering your south-facing windows. Very wide overhangs, such as carports, porches or awnings are effective in reducing solar gain through windows of any orientation. Sunscreens are useful in redirecting solar gain and are easily installed. Several types of movable weatherproof exterior shades and blinds are also available for exterior shading.

- Interior shades offer an easily-controlled last line of defense against unwanted solar gain. Light colored blinds, roller shades and drapes will reflect much of the sun's radiant energy back through the glass. Performance improves with opaque materials, lighter colors, reflective backings, and shades that fit close to the glass. Interior shading is not as effective as exterior shading because some of the heat inevitably escapes into the house instead of being reflected back to the outside.

For best results, use interior shades in conjunction with exterior devices.

GLAZING

The "U-value" is used to indicate the insulating value of a window. The U-value measures the heat flow. The smaller the U-value, the better a material can stop heat flow. Windows are manufactured with a variety of frames, coatings and other treatments to improve their thermal performance.

The effectiveness in stopping heat gain from solar radiation coming through the window is expressed as the shading coefficient, or SC (see "Helpful Terms"). Many options are available for controlling heat gain from solar radiation, and this important factor was considered in constructing your home.

INCREASING THE EFFICIENCY OF YOUR WINDOWS

Energy savings can be increased with proper use of the following devices. Please note that such features on your home must remain as constructed to ensure energy savings.

Until fairly recently, conventional clear glass was the primary glazing material available for residential use. Now several types of windows are available that help control heat loss or gain. These include multi-pane, heat-absorbing, low-E and reflective glass.

- Multi-pane glass windows can reduce the amount of heat conducted through the glass. Such windows have two or three panes of glass with an insulating airspace or gas filler between the panes.

- Heat-absorbing glass can absorb as much as 45 percent of the incoming solar energy, but will transfer much of the absorbed heat to the structure through convection and re-radiation. (See "Helpful Terms.")

- Low-E windows have a coating that inhibits radiated heat transfer from warm walls and floors in the house. For warm climates, savings from low-E glass improve if the coating is placed on the inner surface of the outer pane. This prevents heat absorbed by the outside pane of glass from radiating to the interior of the home.

- Reflective glass is most useful in controlling radiant heat gain in the summer, but reduces solar heating in winter.

DOORS

Air leakage can occur wherever different materials or parts of the house meet. In a typical home, 5 percent of the air leakage occurs around doors.

Manufacturers are required to test and certify all doors placed in California homes to ensure they limit air leakage to those minimum levels allowed. Your new home has weather-stripping on all exterior

doors including those between the garage and house, between furnace rooms and the heated space, and between the attic and heated space. Check that all exterior doors are weather-stripped properly.

INCREASING THE EFFICIENCY OF DOORS

Exterior doors receive constant use and exposure to the weather. At least once annually, check all doors between heated and unheated spaces for tightness of fit. In general, no daylight should be visible and the door boot should fit tightly on the threshold when the door is closed.

Caulking and weather-stripping "plug" any air leaks that you may find. To maintain the weather-stripping around your doors, see the "Air Leakage" discussion.

Air Leakage

Air flow occurs inadvertently as "infiltration" and deliberately as "ventilation." Air leakage into your house is one of the major contributors to high heating and cooling bills. Air leakage, however, not only causes your energy budget to suffer, it also permits dust, noise, fumes and moisture to enter your home. The resulting air must be heated in the winter and cooled in the summer, and represents an additional load on your home's heating and cooling system. This additional load can account for 20 to 50 percent of heating and cooling costs. Figure 2 illustrates the common air leakage areas in a home.

Ventilation

Achieving energy efficiency and maintaining high indoor air quality are compatible goals. Your house is protected from infiltration/exfiltration but you should also practice bringing outside fresh air into your house and exhausting stale air.

Make sure exhaust vents operate and include backdraft dampers. Weather permitting, use natural ventilation by opening up windows when convenient. Some mechanical ventilation systems may be included in your home: spot ventilation (in bathrooms and over ranges), whole house fans, and possibly an air-to-air heat exchanger.

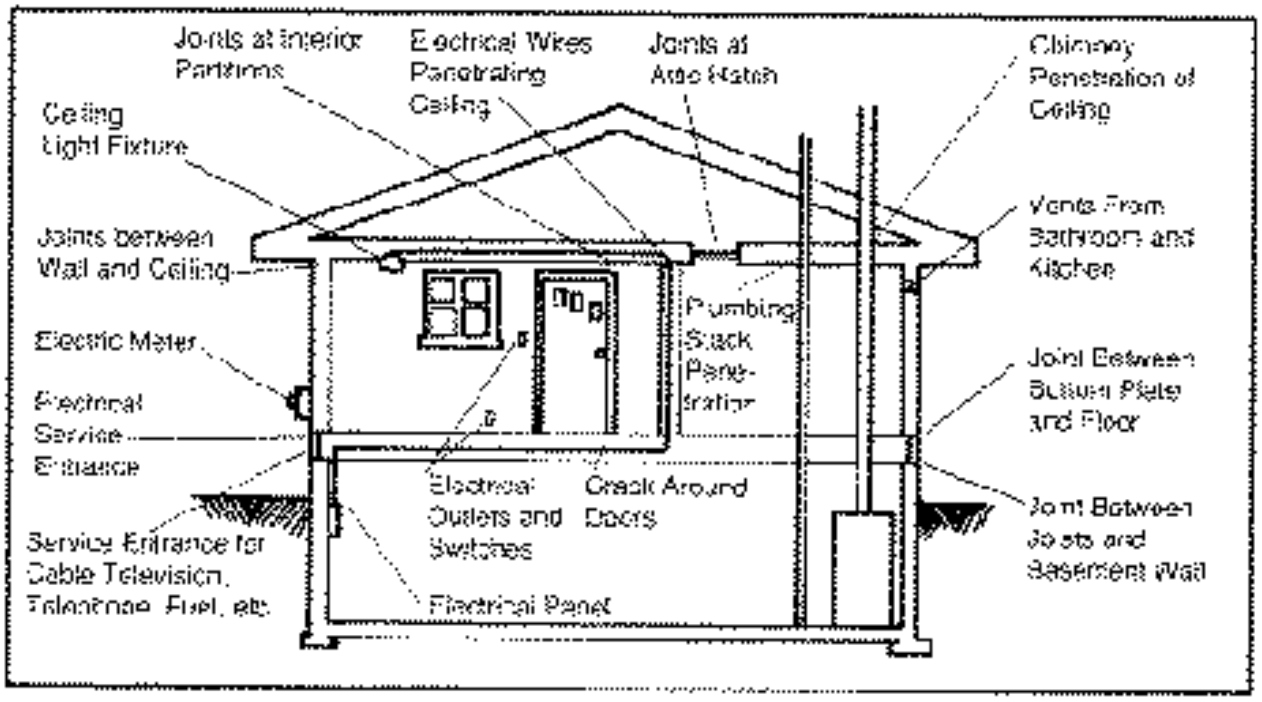


Figure 2. Infiltration/Exfiltration Problem Areas

WHAT TO LOOK FOR WHEN BUYING FIREWOOD

Density of the wood is an important factor to consider when determining the type of firewood to buy. Hardwoods, such as oak, have a higher density and weight per cord than softwoods, such as pine or cedar. Because of the higher density, hardwoods provide a higher heating value per cord. Softwoods, on the other hand, ignite easily and provide good kindling, but they also contain more of the resins that produce corrosive creosote when burned.

When purchasing firewood, make sure it is reasonably dry without being overly dry. If wood is too dry the rate of combustion is high. This condition increases the amount of room air pulled into the fireplace and expands the amount of wood needed to keep your fire going. In contrast, moisture-laden or "green" wood is more difficult to combust and burns slowly or not at all. Also, green wood frequently pops and throws sparks while burning.

It is best to use a mix of dry and green wood, and large and small pieces for a controlled combustion rate. Dry wood is easily recognizable by its color, texture and cracks at the ends of the logs.

CLOSING THE ENERGY LOOPHOLES

Caulking and weather-stripping should be in place with a new house, but needs to be checked periodically. As the house ages and cracks appear, the cracks should be sealed.

An easy way to seal cracks and holes is to use caulking. Inexpensive and easy to apply, caulking requires just a few tools. Exterior caulking has the further benefit of reducing the seepage of moisture into your house. The big payoff with caulking is increased comfort and lower heating and cooling bills.

The best time to caulk is during dry weather, when rain or freezing temperatures are not anticipated within 24 hours. Low humidity is important so that cracks are not swollen shut with moisture, and warmth is needed so that the caulk will adhere. The following is a list of interior and exterior locations to consider caulking:

- Sill plate (where walls meet the foundation, indoors and outdoors)
- Behind baseboards at the joint where the wall and floor meet
- Electrical wiring entrances and exits
- Plumbing entrances and exits
- Telephone line entrances
- Around clothes dryer vent
- Around exhaust fans
- Joints between exterior window frames and siding
- Where the chimney meets exterior siding
- Furnace vent stacks
- Where door frames meet walls
- Where the ducts penetrate walls, ceilings, or floors.

(Refer to Chapter 2 checklist for maintenance intervals.)

DODGING DRAFTS WITH WEATHER-STRIPPING

Weather-stripping is effective at eliminating air leakage when it fits tightly against closed windows and doors. Many different types of weather-stripping are available, including foam rubber, felt, flexible vinyl and spring metal or plastic tension strips. Some are surface mounted and clearly visible, whereas others are concealed when the door or window is closed.

As with many home care products, it pays to spend more initially for quality products that will last longer, especially if you plan to live in your house for the next two to five years. Complete "how-to" instructions are available in most hardware and home center stores.

HEATING WITH WOOD — IN THE BANK ... OR UP THE CHIMNEY

Heating with wood is an attractive supplement, or in some cases, an alternative to conventional "modern" forms of home heating. Until the early 1900s, wood provided up to 90 percent of the nation's energy needs, including most home heating.

As coal, oil, natural gas and electricity became readily available, reliance on wood as a fuel declined to less than one percent by 1970. Interest in wood heating peaked after the 1973 oil embargo when the increasing cost of fossil fuels (see "Helpful Terms") began straining budgets. By the mid-1980s, wood provided about 6 percent of the nation's energy needs.

Although an increasingly popular home heating fuel, wood is not necessarily an efficient source of heat. Your factory-built or masonry fireplace should have these features to increase efficiency (refer to Figure 3):

- Closeable glass or metal doors that cover the opening of the firebox

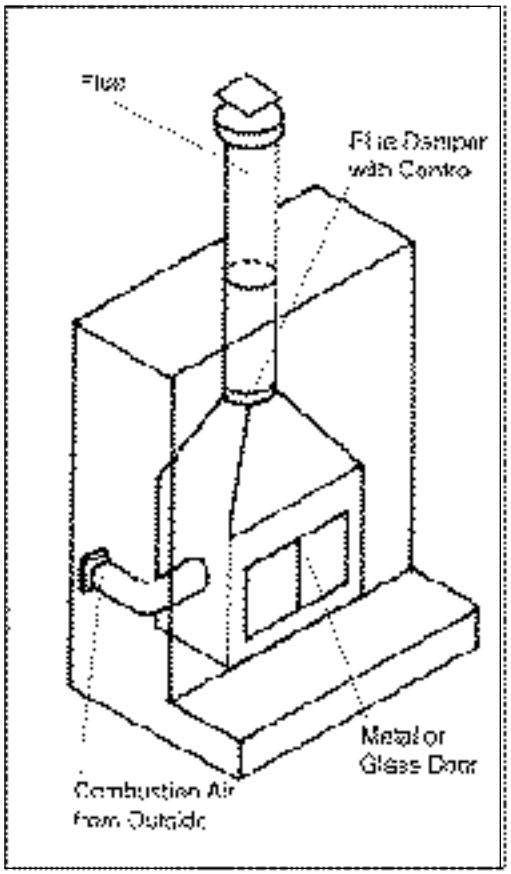


Figure 3.

- Combustion air intake to draw air from the outside directly into the firebox installed and equipped with a damper. (Outside combustion air intakes are not required if the fireplace is installed on a slab floor away from an exterior wall.)
- Flue damper with a readily accessible control

Continuous-burning pilot lights and indoor air vented to the outside to cool a firebox jacket are prohibited. (These requirements do not apply to free-standing stoves.)

PROPER AIR CONTROL IS KEY

In a typical vertical-back or slanted-back open-hearth fireplace, approximately 85 to 90 percent of wood's heating value can be lost up the chimney in the form of hot combustion flue gases. Additional losses can come from preheated room air being drawn into your fireplace to keep the fire burning. Out of a dollar's worth of wood-produced heat, 85-90 cents worth is going up the chimney, while about 10-15 cents worth provides usable heat.

One of the simplest ways to improve fireplace efficiency is to control the source of air going to the fire. The typical fireplace draws in room air to feed the fire, wasting air you have already paid to heat with your central heating system. If your fireplace has an outside air intake, make sure it is open. In masonry fireplaces located on outside walls, a special ventilating brick between the outside and the ashpit can provide an air source.

Tips for fireplace energy savings

Limit the use of your fireplace in severely cold or windy weather when chimney draft is especially strong and room air is drawn out at a faster rate. Set the thermostat back while the fire is burning and close off the room in which the fireplace is located. Finally, when the fire dies down close the glass doors.

Decorative gas appliances

As mentioned, fireplaces must be installed with a flue damper with a readily accessible control. However, for safety reasons decorative gas appliances must be installed with the damper fixed open. This fixed damper makes these items inefficient by drawing heated air from the surrounding area even when not in use. As a result, you may want to balance their aesthetic appeal with your costs both in terms of energy usage and energy bills.

MAKING YOUR FIREPLACE WORK HARDER

Dampers

The damper is a door-like device located in the flue opening. By regulating the amount of air leaving the firebox, the flue damper also regulates the amount of replacement air that must be pulled into the firebox to feed the fire. Opening the damper increases the amount of air going to the fire and increases the rate at which the fire burns. Closing the damper decreases the amount of air and slows the burn rate.

Closing the damper too much while the fire is burning is **dangerous** and will allow smoke to enter the room and eventually cause the fire to go out. Be sure to close the damper when the fire is not burning to prevent unnecessary loss of heated air. Open dampers can allow about 8 percent of home heat to escape up the chimney.

WOOD BURNING STOVES

Wood burning stoves are popular as the cost of energy continues to increase. Advances in stove design make them an efficient, cost-effective and attractive way to supply all or part of the heat in new homes.

Wood stoves offer efficiencies ranging from about 35 percent to as high as 65 percent. High-efficiency wood stoves are built to be relatively "airtight" with controlled air flow to the fire, ensuring maximum use of the wood. These stoves have other features, such as long smoke paths and heat exchangers to extract as much heat as possible from the fire.

Due to their effect on air quality, some areas have local restrictions on the use of wood heat. Check if wood stoves are prohibited in your area. Some areas restrict the use of wood stoves to models that meet local and EPA performance requirements.

THERMAL MASS SAVES ENERGY

Thermal mass is any material that absorbs and releases a significant amount of heat when a temperature difference occurs between the mass and the air around it, such as concrete, brick or tile. Usually, the most significant portion of thermal mass is what you stand on, such as a concrete slab floor. Tile countertops and masonry fireplaces are also considered thermal mass.

THERMAL MASS HELPS INCREASE COMFORT

As the air in your home warms, thermal mass absorbs some of the heat, which slows the rise of the inside air temperature. As the air in your home cools and falls below the temperature of the thermal mass, the thermal mass slowly releases its stored heat, keeping your home warm for a longer period of time.

This process of absorbing and releasing heat helps keep your home in a comfortable temperature range. When indoor temperatures naturally stay close to your comfort level, heating and cooling equipment is used less. This is why thermal mass is important in your overall reduced use of gas and electricity, and key to your dollar savings as well. Thermal mass requirements in your home vary according to its design.

MAXIMIZE THE BENEFITS OF THERMAL MASS

The value of thermal mass increases — and it works as designed — when it is exposed to room air, rather than covered by materials that hinder its absorbing and releasing effects. For example, a concrete slab covered by vinyl or tile performs dramatically better than a concrete slab covered by

HUMIDIFYING YOUR HOME

Nothing dries out a house more quickly than heating with a wood stove. Humidifying your home makes the air retain heat more efficiently, and is better for general health. A durable top-filling cast iron steamer that holds three quarts of water can be found in many home stores and is useful for increasing humidity. Try to find one that has a lattice top to allow greater release of moisture-laden steam.

carpeting or cabinets. The following techniques will help to increase the value of thermal mass.

Winter operation

During the day, open shades to allow direct sunlight to heat the indoors. Close windows and doors and use exhaust fans sparingly. At night, the heat stored in thermal mass continues to warm the rooms in your home. Thermal mass works best if the sun shines directly on it in the winter. Even mass in a north room is beneficial because it absorbs heat from the air and releases it back when the room cools.

Summer operation

During the daytime, make sure all windows and skylights are well shaded to keep out direct sunlight, and close your windows and doors to keep out heat. Use exhaust fans to vent heat created by cooking, bathing and washing. Consider using alternative methods for cooking to create as little heat as possible, for example, by barbecuing outdoors or using a microwave oven to cook.

In the evening, or when the outside air is cooler than the inside air, let in as much air as possible to let thermal mass release the stored heat it absorbed during the day and cool down to absorb heat the next day. Open windows and vents, or use a whole house fan to flush out the inside air. This use of the mass can substantially reduce or eliminate the need for mechanical air conditioning.

SETBACK THERMOSTATS

A built-in benefit of your new home is a heating and cooling system with an automatic setback thermostat. Its clock mechanism has the capability to turn back thermostat setpoints at least twice in each 24-hour period. The setback thermostat saves energy by providing heating or cooling only when it is needed. Proper use of the thermostat can increase your energy savings from 20 to 75 percent during the heating season and 15 to 25 percent during the cooling season. The actual energy and cost savings resulting from the setback thermostat depend on a number of factors, including your home's design, amount of insulation, climate, temperature settings, utility rate structures, and your style of energy use.

Use your thermostat properly to enjoy the energy and dollar-savings it offers. Take a few moments to read the thermostat operating instructions on how to properly set your automatic thermostat to enjoy increased comfort, convenience and energy savings all year long.

CONVENIENCE WITH SETBACK THERMOSTATS

If you tried to save energy with a manual thermostat, you might lower the thermostat before going to bed, turn it back up in the morning, then turn it down again when you left for work and up again when you arrived home. You would have to remember to set and reset the thermostat each day, and you would awaken to a cool house and then wait for the furnace to re-heat the house.

Your automatic setback thermostat performs all of these services for you — automatically — according to a schedule that you select. When heating your home, setting the thermostat back for a period as short as four hours per day can save a significant amount of energy and reduce your energy costs. This is because the amount of heat your house loses depends on the difference between the indoor and the outdoor temperatures. When the indoor temperature is closer to the outdoor temperature, your house loses less energy.

Winter operation

It is best to set your thermostat to keep the house at 55° Farenheit (F) at night, warm it up to 68°F, or to a temperature you prefer, 30 minutes before your household awakens, allow it to drop to 55°F when your family members leave for the day, warm it up again just before they return, and allow the temperature to drop back down to 55 °F just after going to sleep. (You should not set your thermostat below 50°F because your indoor water pipes may freeze on an extremely cold day.)

Summer operation

During times when you are at home, your thermostat could be set to 78°F (or higher if you're comfortable), and 85°F or higher when no one is at home.

INCREASE YOUR ENERGY SAVINGS

While setback thermostats increase comfort and save valuable dollars and energy, you may choose to enhance these benefits with a more advanced, programmable setback thermostat. This thermostat can offer up to six different setpoints programmed to accommodate your lifestyle and to shut down the heating or cooling equipment when it is not needed.

Many programmable thermostats also offer a different schedule for Saturdays and Sundays. Generally, the more features a thermostat has, the greater the expense; however, it also offers more potential energy savings and comfort.

When you shop for a programmable thermostat, compare such features as programming options, display, ease of programming, battery backup, temporary override and warranty.

Maintaining Comfort With Your Heating and Cooling System

Blizzards may not occur in most areas of California, but winter heating is still a major portion of household energy budgets. Depending on your region of the state, air conditioning also may account for a significant portion of your annual energy investment.

The energy efficiency of your home depends not only on having a tight, well-insulated structure, but also on having a heating and cooling system that operates efficiently. Inefficient systems use more fuel than they should and cost you more in energy bills. Prior to installation, your heating and cooling equipment was certified as meeting energy efficiency standards; that is, the unit should operate efficiently for the size of your house. Check the CF-1R form to determine the efficiency rating and type of heat and air conditioning equipment installed in your home.

Equipment that requires certification includes room air conditioners, central air conditioning heat pump, central air conditioners and central gas furnaces. Gas-fired space heaters also require certification.

Several types of heating and cooling systems are available. The following describes the major forms of heating and cooling equipment that might be found in your home.

Check the CF-1R form enclosed with this manual to see the type of system installed in your home and any special features the equipment may have. Also, check that a detailed sizing calculation was done for heating and cooling to be sure your equipment is the proper size for your home.

Read your operating manual and the relevant portions of this section before using your heating system.

HEAT PUMPS

A heat pump is the most efficient way to electrically heat your home and provides either heating or air conditioning. In its cooling mode, a heat pump works like an ordinary air conditioner. But unlike an air conditioner, the heat pump can reverse during cold weather, absorbing heat from the outdoor air and transferring it indoors.

When the outside temperature is too low for the heat pump to work at maximum efficiency, auxiliary heating-strips turn on automatically to ensure sufficient heat. Electric strip heaters are expensive to operate, so you need to learn how to minimize their use. Though air-to-air is the most common type of heat pump, water-to-air and ground-to-air heat pumps are also available. Water-to-air heat pumps exchange heat with either ground surface water or well water. Ground-to-air heat pumps exchange heat with the ground.

Should your house have a central heat pump, be sure to check the operator's manual for maintenance and operation details. Follow the use and care tips for central air conditioning systems when maintaining your heat pump.

Use and care tips.

A heat pump operates differently from a furnace. Let the thermostat turn your heat pump on and off in the winter. It can be costly to manually turn it on and off since this may cause the electric strip heaters to operate. The "intelligent" thermostat controls the strip heaters to keep their use at a minimum. Make sure you read the operating manual before using the heat pump.

To keep your heat pump operating at maximum efficiency, have it serviced every two to three years.

GAS FURNACES

Gas systems are fueled by natural gas, propane or butane. Most have a forced-air combustion type of gas furnace for heating that consists of a furnace, ducts and registers. Air returned from the rooms in your home passes over a heat exchanger (a steel chamber in the furnace that transfers heat from the combustion process) and is blown through the air-supply ducts and recirculated throughout the house.

Locate your furnace and identify where to change the filters (refer to the furnace operating manual).

Use and Care tips.

To operate efficiently, a gas heating system requires regular tuning or servicing. Service at the beginning of each heating season assures the system's efficient operation.

A qualified service person should perform the maintenance check; be sure the following areas are examined:

- Safety features operate correctly so that the system will shut down if a hazardous situation arises
- Heat exchanger checked for cracks in the steel chamber
- Duct system checked and well sealed and not blocked or constricted
- Blower section checked to determine the motor and bearings are lubricated and belts have proper tension
- Filters replaced

If any of these areas have problems, do not operate the system until corrected. In addition to seasonal professional maintenance, change air filters monthly when the system is in use.

HYDRONIC HEATING SYSTEMS

A hydronic heating system provides space heating using hot water. Combined hydronic systems provide both space heating and domestic hot water. Hydronic space heating methods include radiant panel systems, convective radiators, and fan-coil systems. Storage tank water heaters or boilers create the necessary heat.

Use and care tips.

In closed-loop hydronic systems, check the water once every two years. Follow the recommendations in the equipment manual.

CENTRAL AIR CONDITIONING SYSTEMS

Air conditioning does more than cool the air. It actually "conditions" the air by removing dust and dirt as the air is drawn through a filter. Your air conditioner has the built-in benefit of meeting a minimum standard for energy efficiency.

Air conditioners vary greatly in energy efficiency. The efficiency rating of a unit is called its EER or energy efficiency ratio (see "Helpful Terms"). Instead of an EER rating, many central air-conditioning systems have an SEER or Seasonal Energy Efficiency Ratio. The higher the EER or SEER, the more efficient the unit and the more money saved on cooling bills. SEER ratings generally range from 9 to 14, and the initial cost of the unit increases as the rating increases.

Find the air conditioning unit for your house; the condenser is usually installed outside on a pad. Check the CF-1R form to find the efficiency rating of your system.

ENERGY EFFICIENT LANDSCAPING

Landscaping can provide an effective natural way to moderate heat loss and heat gain in your home and help reduce your cooling and heating bills. A deciduous shade tree can provide shade for portions of the roof and walls and, upon maturity, can reduce cooling costs by up to 20-40 percent and still allow solar heat gain in the winter when the leaves fall. In addition, air drawn into the house from shaded areas will be relatively cooler. Shrubbery planted a few feet away from the house provides extra shade without obstructing air currents. Some trees and shrubs also can be used as natural windbreaks to cut down on heating costs.

Landscaping is not an alternative to weatherizing your house, but an additional way to help lower energy consumption and costs. The amount of money saved depends on your home's location and type, and on wind and weather conditions.

(See Chapter 3 for a further discussion of landscaping.)

If you replace your present unit, buy a unit with the highest SEER rating you can afford, preferably one with a rating of 11 or above. As with other energy-consuming appliances, when you buy a unit you pay more than just the sales price — you commit yourself to paying the cost of running the appliance over its lifetime.

Use and care tips.

Proper use of your dual setback thermostat will ensure energy savings. Even the most energy-efficient air conditioner will waste valuable energy (and dollars) if not operated and maintained properly.

Before the cooling season, an annual check should be made by a qualified heating and cooling service person. Preventive maintenance on your system should include:

IF YOU HAVE A "ZONED" SYSTEM

Your home may be designed with an effective energy efficiency measure called "zonal control." Do you have more than one furnace or air conditioner? If so, you may have zonal controls. Your "Certificate of Compliance" (described in Chapter 4) will show whether your home has been designed with zonal control capability.

In a zonally controlled home, "living" and "sleeping" area systems are controlled separately and with separate thermostats. This allows control over which areas of your home are to be heated or cooled, based on your own individual lifestyle.

As an example, if you go to work in the morning and return in the late afternoon, you might use the zonal control capability to set back both living and sleeping area thermostats when you leave for work in the morning. The living area thermostat would start heating about one hour before your return in the afternoon, reaching desired temperature upon your return. When retiring at night, the living area thermostat would be set back to a lower temperature and the sleeping area thermostat would be set up to increase the temperature.

By these methods you benefit from the zonal control capability in your home while saving energy and increasing your comfort.

- Oiling the condensing unit fan motor
- Cleaning the condensing coil fins and condenser fan
- Checking the condensing unit for refrigerant leaks
- Inspecting the compressor start- and run-capacitors for leaks
- Cleaning the air supply fan motor housing and oiling the motor annually
- Checking the fan control switch

EVAPORATIVE COOLERS

The evaporative cooler is an efficient way to cool homes in dry climates and may be installed as an alternative to air conditioning. These systems use water evaporation and air circulation to provide cooling. The cooling occurs as air is pulled through fibrous pads (commonly made of shredded wood or cellulose) that are kept wet by water pumped through the water distribution system.

Use and care tips.

To ensure proper operation of the cooler, certain steps must be taken to maintain it in working condition. The pads should be replaced at least once a year, and they should be flushed with a water hose whenever salt buildup is evident. The water in the reservoir should be drained and replaced monthly, and the distribution lines should be periodically checked to ensure that none are plugged by debris.

DUCTS: CLOSING OFF ENERGY WASTE

Ducts carry heated or cooled air from furnace or air conditioner to the rooms in your home. Check where ducts are located and the amount of insulation they have. The CF-1R form will help to identify the ducts.

Air leakage out of your home's duct systems can add to heating and cooling costs, reduce the overall efficiency of equipment, lessen the level of comfort, and cause problems with the health and safety of your home. Energy loss occurs when duct work must pass through unconditioned areas, such as the attic or crawl space. To minimize these losses, the ducts leading to your home's vents must be attached, taped and sealed, and have R-4.2 insulation or greater.

WHEN REPAIRING DUCT WORK

In the future, you may suspect that your heater isn't working properly and, upon inspection, discover deteriorated duct tape rather than a problem with heating equipment. Duct work is an important factor in energy efficiency, and air leakage to and from ducts will offset any savings expected from your well-insulated home.

The adhesive on the cloth "duct tape," or similar product originally used to seal ducts, may not have been designed to provide an airtight seal over the life of your home. Periodic inspection and repair will ensure properly sealed ducts.

Supply ducts carry conditioned air from the heating and cooling equipment to the house and the return ducts carry room air back to the equipment. Your local hardware store will assist in terms of selection of duct sealant. It is critical, however, that the seams of all ductwork be sealed in both return and supply ducts with a high temperature tape, mastic, or other suitable material. Traditional "duct tape" has a short life and should be avoided as a replacement sealant.

TIPS FOR ADJUSTING HEATING AND COOLING SYSTEMS TO WORK MORE EFFICIENTLY

Energy dollars can be wasted by overworking your air conditioning or heating system. Here are some ways to make your systems work more efficiently.

If you have a single, central system with cool or warm air distribution ducts, you may be working the entire system just to get some cooling or warmth to the part of your home farthest from the central air conditioning or heating unit.

Make sure the duct system isn't leaking.

Check the ducts that carry the air to different areas of your home. Make sure that all of the ducts are connected, particularly after someone has been working in your attic or crawlspace. Close up any leaks at joints. Your local hardware store can help select a high temperature tape, mastic, or other suitable material for the job. You may want a professional to help.

Make sure the system is balanced.

"Balancing" the system involves adjusting the volume control dampers (if your system has them) and adjusting the air supply registers.

Although you can make adjustments yourself, the best way to properly balance an entire system is to call in an expert, who has special instruments and can make all needed adjustments.

Caution: To avoid damage to the system, most of the air supply registers on an air conditioning or heat pump system should remain at least partially open. Also, closing rooms with a supply vent (not a return vent) can cause inefficiency and damage.

Clean or replace filters; clean the coil.

A filter on your heating or cooling unit may be blocked by the dust and dirt it has screened out of the air. A clogged filter will make the unit run longer and use more energy. Some filters can be washed; others need to be replaced, perhaps every month or two. On an outdoor heat pump or air conditioning unit, cleaning the coil is also important to ensure efficient operation.

Clear away obstructions.

Move any furniture, draperies, or other obstructions that may block the flow of heated or cooled air from registers or from individual heating or air conditioning units.

Refer to Chapter 3 for other ways to cool your house.

ROOF VENTILATION

The energy-efficiency standards require adequate roof or attic ventilation. Vents for airflow should be in both the upper and lower part of your attic and be free of obstructions such as insulation. Make sure air flow is not blocked in your attic. If the attic's summer heat is not well-vented, it can heat the living area and cause your air conditioner to work harder. In the winter, the attic is cooler than the rest of the house and condensation may form in the upper walls and ceiling near the attic. Without proper attic ventilation, condensation can damage wood, insulation, paint, metal and plaster.

VENTILATING YOUR HOME WITH EXHAUST SYSTEMS

New building techniques and higher fuel prices combine to make air-tight houses both possible and desirable.

Exhaust fans and other exhaust systems in your home are equipped with backdraft or automatic dampers to prevent outside air from coming into the room when the fan is not in use. Examples are kitchen range-hood exhaust fans or bathroom exhaust fans. Your home may be equipped with a mechanical ventilation system or an air-to-air heat exchanger.

ACTION:

To save energy, set your water heater to 120°F if your dishwasher has a water booster heater. If not, set the water heater to 140°F.

USING THE VENTILATION SYSTEM

Kitchen and bathroom exhaust fans should be used only when needed to remove heat and moisture from these areas.

CARE OF THE VENTILATION SYSTEM

Mesh filters in the kitchen range-hood fan should be cleaned regularly to reduce the risk of fire and to keep the pulling power of your fan at its maximum. This also keeps the walls, floors and ceiling clean. A dirty filter is a fire hazard. Clean permanent filters by swishing them up and down in hot, sudsy water, then rinse with hot water and allow to drip dry. Disposable filters should be replaced every four months.

The fan blades and motor should be cleaned with a damp, sudsy cloth. Neither the fan nor the motor should be placed in water. Be careful not to bend the fan blade.

When cleaning the hood over your stove, clean the top and underside with a damp, sudsy cloth. Cleaning the underside is important since deposits form a hard residue that is difficult to remove if not cleaned regularly.

PLUMBING SYSTEM

Your new home is equipped with a well-engineered plumbing system that consists of an energy-saving water heater and shower heads and faucets equipped with "flow control" devices.

WATER HEATER

When thinking about "where" your energy dollars go each month, most things that come to mind are out where you can see them: lights, kitchen appliances, and air-conditioning and heating systems.

Water heating is one of those overlooked energy expenses. You may be surprised to know that water heating accounts for as much as 20 percent of your energy consumption and energy bills, and possibly an even higher percentage in areas with mild climates. The good news is that you will enjoy major energy savings with your new home's energy-efficient water heater.

HOW YOUR WATER HEATER SAVES ENERGY

Water heater insulation

The "energy saving" water heater in your home is better insulated than those manufactured years ago. As a result, it costs about 18 percent less to operate than did earlier models, mostly due to the reduced heat storage loss from better insulation. In addition to improved insulation, new gas water heaters have improved combustion efficiencies. Less energy is permitted to escape up the flue, so less gas is required to heat the water.

Tank insulation R-values range from 4.6 to 20, depending on the type and amount of insulation used. Although not required, the tank should be insulated to a combined R-value of 16 or more. The only water heaters required to be wrapped with an insulation blanket of at least R-12 are indirect storage tanks and backup tanks for solar water heating systems.

Pipe insulation

Hot water pipe insulation helps maintain the water's temperature level. Water heater pipes (both hot and cold) must be insulated in all California homes to at least a value of R-4 on the five feet of pipe closest to the water heater.

If you have a combined hydronics system with a water temperature above 105 ° F, pipes were required to be insulated at time of installation. Recirculating system pipes also must be insulated.

To save energy, set your water heater to 120 ° F if your dishwasher has a water temperature booster. If not, set the water heater to 140 ° F.

Care for your water heater

One factor that can lead to extra expense over time is hard-water scale buildup on the inside of the hot-water tank. Hard water produces a scale of calcium or magnesium on heating element surfaces and reduces

their efficiency of heat transfer. Scale also shortens the life of the water heater. If you suspect that you have hard water, have the water analyzed and consider installing a water-softening system in the water line before the water enters the water heater.

SOLAR WATER HEATING

Solar systems can provide substantial savings in utility bills and enhance the value of your home. Passive and active solar hot water heaters can provide households with a large portion of their hot-water needs while cutting back on home energy costs.

If your home has a solar water heating system, it includes solar collectors, insulated pipes to and from the collectors, an insulated storage tank, and a back-up system either as part of the storage tank (electric) or a separate water heater (gas).

Be sure to follow the manufacturer's operating and care instructions. It is important to periodically clean the solar collector(s) for peak efficiency. Check for leaks in the system and loose collector and mounting brackets, and make sure drain-down valves function properly.

Refer to Chapter 3 for suggestions regarding remodeling.

SHOWER HEADS AND FAUCETS

Your shower heads and faucets were certified as meeting minimum flow standards. These flow standards save water as well as the energy required to heat water. The "flow control" devices in your shower heads and faucets restrict the amount of water used at the source.

Caring for your plumbing system

Leaks. Leaky faucets are a common water-heating energy waster. The energy used to heat the water goes down the drain along with the unused water. Water leakage accounts for between 5 and 10 percent of all residential water consumption. A steady stream of as little as 1/32 inch leaking from a hot-water faucet could equal 6,000 gallons in one year, or the equivalent of 200 baths.

A leaking faucet means either that the washer has worn out or that excessive sediment has collected on the valve seat. Extra washers can be obtained in any hardware or variety store. Replacement is easy.

Aerators. In maintaining your faucets, cleaning the aerators will be your most frequent task. This attachment to the faucet-proper adds air to the water as it leaves the faucet, reduces splashing, and provides some savings because less water is used. Aerators are found most typically on kitchen faucets, but also are used for bathroom sinks. To clean an aerator, unscrew it from the mouth of the faucet; remove any debris; remove and rinse the washers and screens; replace them in their original order and put the aerator back on the faucet. Frequency of cleaning depends on the condition of the water, but every three or four months is more than adequate.

SWIMMING POOL OR SPA HEATER

If you have a swimming pool or spa, its heating system has been equipped with an easy-to-access on/off switch mounted on the outside of the heater. It also has a permanent weatherproof instruction plate or card and at least 36 inches of plumbing between the filter and the heater. This allows for the future possible addition of solar heating equipment.

If a fossil-fuel heated pool or spa is installed with your new house, it requires a cover, time clock and directional inlets that provide an adequate flow of water. Swimming pool heaters also must have a thermal efficiency of at least 78 percent.

The filter pump

Your swimming pool or spa's filter pump may be among your home's largest users of electrical energy. You can save energy by reducing the operating time of the filter pump. Putting your pump on a time schedule has nothing to do with using the pool or spa. Due to differences in pool volume and equipment, time requirements for pool filtering vary from home to home. Generally, one complete water turnover every 24 hours provides adequate filtering for a single-family backyard swimming pool.

The filter should be cleaned to obtain maximum efficiency as recommended by the manufacturer. Use a wall brush and leaf skimmer regularly and remove foreign materials from the strainer baskets in the pump and skimmer.

Heaters

The swimming pool heater can be a major energy user. If you heat your pool (other than with solar), set your filter time-clock to start the pump no earlier than 6 a.m. during the pool-heating season, the time when nightly heat loss stabilizes.

In addition, follow a regular program of preventive maintenance for your heater. An annual inspection and de-liming of the heat exchanger when necessary will maintain heating efficiency.

Pump schedule

You can help reduce electricity demand by turning pump equipment off between noon and 6 p.m., the utility company's peak demand hours. This is accomplished by adding two tripper devices to the automatic time clock that controls your pump equipment. Your utility may have a program to provide these for you.

Covers

It takes more natural gas to heat an uncovered pool from May to September than it does to heat a new home all year long.

Keep your pool or spa covered when not in use. A cover prevents water evaporation and can save hundreds of gallons of water each month. Covers reduce heating bills by preventing night heat loss, and also save on chemicals.

Well-trimmed hedges or other landscaping, a cabana, or fencing that functions as a windbreak, shelters your pool from prevailing winds.

LIGHTING

Total light output is measured in lumens, and the amount of electricity a lamp or bulb uses to produce light is measured in watts. The most energy-efficient bulb or lamp for any given application is generally one that produces the most lumens per watt.

Incandescent light bulbs are the least efficient light source available, usually producing less than 20 lumens per watt. Use compact fluorescents or fluorescent tubes wherever possible. Fluorescent lamps generally produce more than three times the light for the same watts as incandescent bulbs and last 10-20 times longer. This is why fluorescent lights should be used wherever possible, both indoors and outdoors. Manufacturers print figures for watts and lumens on the product package.

At least one light fixture in each bathroom and general purpose kitchen lighting fixtures must have an efficacy of at least 40 lumens per watt. The kitchen's first accessible switch must control the high efficacy fixtures (usually fluorescent) for general lighting. In the bathroom, at least one fixture must be high efficacy (fluorescent) and controlled by the first accessible switch.

MAJOR APPLIANCES

In the average California household, major appliances account for more than 75 percent of all energy consumed. Such appliances include the furnace, refrigerator, refrigerator-freezer, freezer, water heater, clothes washer, clothes dryer, dishwasher and air conditioner.

Your furnace, water heater, air conditioner, refrigerator, refrigerator-freezer, freezer and fluorescent lamp ballasts are manufacturer-certified as energy efficient. In addition, most new gas appliances are no longer equipped with continuously burning pilot lights. Continuously burning pilot lights have been replaced with electronic intermittent ignition devices, a restriction applying to household cooking appliances, pool heaters and clothes dryers. Refer to Chapter 3 for further information on appliances.

CHAPTER 2

MAINTAIN AND IMPROVE ENERGY EFFICIENCY OF YOUR HOME

MAINTENANCE CHECKLIST

The following checklist identifies maintenance needed monthly, seasonally and annually for equipment in your home. For more details, refer to use and care tips in Chapter 1 and the appropriate operator's manual.

MONTHLY MAINTENANCE:

- ☐ Gas Furnaces — change air filters during heating season
- ☐ Evaporative Coolers — drain and replace water in reservoir
- ☐ Heating and Cooling System — clean or replace filters and clean coil

THREE – FOUR MONTHS:

- ☐ Ventilation System — clean filters in range hood
- ☐ Faucets and Showerheads — clean aerators if water is hard
- ☐ Refrigerator/Freezer — vacuum coils located on the bottom

SEASONAL MAINTENANCE:

- ☐ Infiltration/Exfiltration — caulk in dry weather
- ☐ Gas Furnace — service at beginning of each heating season
- ☐ Faucets — wrap outdoor pipes with insulation
- ☐ Whole House Fan — check belt tension and shutter action and oil motor bearings

ANNUAL MAINTENANCE:

- ☐ Doors — check tightness of fit and weather-stripping
- ☐ Infiltration/Exfiltration — check for leaks
- ☐ Setback Thermostat — preventive maintenance/ test system
- ☐ Evaporative Cooler — replace pads
- ☐ Swimming Pool or Spa Heater — inspect, de-lime heat exchanger
- ☐ Refrigerator/Freezer — vacuum coils located on the back

GENERAL MAINTENANCE:

- ☐ Ventilation — seal all cracks, joints and other openings and check backdraft dampers
- ☐ Heat Pumps — professionally service every two to three years
- ☐ Ducts — periodically check ducts for proper seals, especially after anyone has been in the areas where the ducts are located
- ☐ Solar Water Heaters — clean collectors periodi cally and check for leaks
- ☐ Swimming Pool or Spa Heaters — use wall brush and skimmer frequently and regularly remove foreign material from strainer baskets in heat pump

Ways to Save Energy

There are many easy, common-sense ways to reduce energy costs and make your home more comfortable. Home energy consumption could be cut significantly without personal inconvenience and with great financial savings. For example, turn off your appliances when not using them. Remember to turn off your radio, TV, or stereo when you leave the room. Keep appliances in good working order so they will last longer, work more efficiently, and use less energy. Here are other energy-saving tips:

REDUCE AIR CONDITIONING ENERGY CONSUMPTION

- In the summer, set the thermostat at 78°F or higher if you are comfortable. Lowering the thermostat to 72 ° F could increase your cooling costs 12 to 47 percent, depending on where you live.
- Take advantage of natural cooling breezes whenever possible.
- If possible, provide shading for the air-conditioning unit compressor with vegetation or other shading device. All shading must allow for air circulation.
- Turn the system off when leaving the house for several days.
- Shade windows and glass from the outside as much as possible to avoid direct solar gain. Keep out the sun with deciduous trees, louvers or awnings at windows; indoors draw draperies, blinds, or shades. Plant low shrubs near south and west walls to help keep walls cool.
- Turn off lights not in use. They needlessly add to your equipment's cooling load.
- Use ceiling fans or small electric fans to circulate the air. Because moving air makes you feel cooler, you can set the thermostat higher and still be comfortable.
- Close all unnecessary openings such as fireplace dampers, doors and windows.
- Close off unused rooms and partially close vents in those rooms.
- Keep heat sources such as lights and televisions away from the thermostat. The heat produced "fools" the thermostat and causes the air conditioning unit to run longer in the cooling season.

HEAT SAVING TIPS

- Do not block or cover registers and heating units with furniture and draperies.
- Open the draperies on sunny exposures during good weather and close them at night and during cloudy periods.

ENHANCE YOUR VENTILATION SYSTEM

- Regularly clean filters, fresh air intakes, condenser coils, supply registers and return grills. Dust and dirt will cause your equipment to work harder, wasting energy dollars.
- When heating or cooling your home, close doors and vents to unoccupied rooms. If you have central air or heat, never close more than half the registers at one time as equipment could be damaged by forcing conditioned air through closed ducts.
- A necessary "all seasons" requirement is proper attic ventilation. In hot weather, adequate ventilation eliminates high attic temperatures and reduces subsequent heat gain in the home. During the winter, ventilation helps prevent moisture from condensing in insulation, structural timbers, shingles, or on the roof.

SAVE LIGHTING ENERGY

- Use fluorescent lights whenever possible; they give out more light for each unit of electricity they consume.
- Use compact fluorescents to replace incandescent lighting. They fit in most light fixtures and give off light that looks similar to incandescent light bulbs, while using one-third the energy and lasting 10 times as long.
- Turn off lights in any room not in use.
- Light-zone your home and save electricity. Concentrate lighting in reading and working areas and where it's needed for safety (stairwells, for example). Reduce lighting in other areas, but avoid sharp contrasts.
- Replace bulbs throughout the house with bulbs of the next lower wattage where fluorescents cannot be installed.
- Consider installing solid state dimmers or high-low switches when replacing light switches. They make it easy to reduce lighting intensity in a room. Rheostat type dimmers do not save energy.

- Use one large bulb instead of several small ones in areas where bright light is needed.
- When in need of new lamps, consider the advantages of three-way switches. Use the high switch only for reading or other activities requiring brighter light.
- Reduce glare and use less energy by turning three-way bulbs down to the lowest lighting level when watching television.
- Use low-wattage night-light bulbs.
- Try 50-watt reflector floodlights in directional lamps (pole or spot lamps). These floodlights provide about the same amount of light as standard 100-watt bulbs but at half the wattage.
- Try 25-watt reflector flood bulbs in high-intensity portable lamps. They provide about the same amount of light but use less energy than the 40-watt bulbs that normally come with these lamps.
- Keep all lamps and lighting fixtures clean. Dirt blocks light.

ENERGY-SAVING LIGHTING ASSISTANCE DEVICES

TIMING DEVICES

Mechanical devices available at hardware and variety stores automatically turn lights on and off at pre-set, predetermined times. They are most appropriate in areas such as a garage or storage areas where lights may be left on inadvertently.

DIMMER CONTROLS

Dimmers let you adjust the level of light in a room in response to varying levels of light needed at different times of the day. Remember, most dimmers are not automatic and must be used regularly to realize any savings. Dimmers should not be used with most fluorescent lamps since they may damage the fixture.

OCCUPANCY SENSORS

This device controls lighting — both indoors and out-of-doors — based on the sensor's determination of whether or not people are in the area. The most common occupancy sensor is based on movement. When the sensor detects motion, such as someone walking near the light, the sensor automatically turns on the light. It will then shut off a few minutes after it last detects movement. Sensors are easy to install and are available in hardware stores and lighting supply stores.

MANAGING ENERGY IN THE KITCHEN AND LAUNDRY

KITCHEN ENERGY SAVERS

Cooking energy savers

- Use cold water rather than hot to operate your food disposal. This saves energy needed to heat the water, is recommended for the appliance, and aids in getting rid of grease. Grease solidifies in cold water and can be ground up and washed away.
- When boiling water always use a cover on the pan.
- Keep range-top burners and reflectors clean to reflect the heat better and save energy.
- If you cook with electricity, get in the habit of turning off the burners several minutes before the allotted cooking time. The heating element will stay hot long enough to finish the cooking without using more electricity. The same principle applies to oven cooking.
- Use small electric pans or ovens for small meals rather than the kitchen range or oven.
- When cooking with a gas range-top burner, don't use a higher flame setting than necessary.
- When using the oven, bake several items at the same time. Preheat for only five minutes; turn off the oven 10 minutes ahead of time.
- Select the right pot for the right burner. Use a small pot on a small burner.
- Microwave as much as you can in the cooling season. Use the microwave for small, quick jobs like reheating or boiling a cup of water. Microwaves take less time to heat or cook and therefore save energy.

Dishwashing energy savers

- Always wash full loads, use the "short cycle" and "air dry" selections on your dishwasher.
- Scrape dishes before loading them into the dishwasher so you won't have to rinse them. If dishes need rinsing, use cold water.
- Let dishes air dry. If you don't have an automatic air-dry switch, turn off the control knob after the final rinse. Prop the door open a little and the dishes will dry faster.
- Don't use the "rinse hold" on your machine for just a few soiled dishes. It uses 3 to 7 gallons of hot water for each use.

ACTION:

If you cook with electricity, get in the habit of turning off the burners several minutes before the allotted cooking time. The heating element will stay hot long enough to finish the cooking without using more electricity.

Refrigerator/freezer energy savers

- To improve efficiency by as much as 30 percent, vacuum the coils on the back or bottom of your refrigerator when dirty. Vacuum rear coils perhaps once a year; vacuum coils on the bottom three to four times per year.
- Make sure your refrigerator door seals are airtight. Test by closing the door over a dollar bill so it is half in and half out of the refrigerator. If you can pull the bill through the seal easily, cold air is escaping from the refrigerator. The latch may need adjustment or the seal may need to be replaced.
- Keep your freezer full. The mass of frozen foods will enable the freezer to recover more quickly after the door is opened.
- Don't keep your refrigerator or freezer too cold. Recommended temperatures: 38°F to 40°F for the fresh food compartment of the refrigerator; 5°F for the freezer section.
- Regularly defrost manual-defrost models. Frost buildup increases the amount of energy needed to keep the motor running.
- Reduce how often you open the refrigerator or freezer door. Most of the cold air is lost as the door is opened. It's better to open the door for one longer period of time, taking out all the items you need, than to open the door several times, taking out one item at a time.
- Allow hot foods to cool before refrigerating or freezing.
- Keep frequently used items in a handy spot.

LAUNDRY ENERGY SAVERS.

Clothes washers

- Wash your clothes in warm or cold water, rinse in cold. Use hot water only if absolutely necessary.
- Wash when you have full loads unless the washer has a small-load attachment or variable water levels, but do not overload it.
- Don't use too much detergent. Oversudsing makes your machine work harder and uses more energy.
- Presoak or use a soak cycle when washing heavily soiled garments. You'll avoid two washings and save energy.

Clothes dryers

- Fill your dryer but do not overload it.
- Clean the lint screen by removing lint after each load.
- Keep your dryer's outside exhaust clean. A clogged exhaust lengthens the drying time and increases the amount of energy used.
- If your dryer has an automatic dry cycle, use it.
- Dry your clothes in consecutive loads. Stop-and-start drying uses more energy because a lot goes into warming the dryer to the desired temperature each time you begin.
- Since lightweight items take less drying time, separate drying loads into heavy and lightweight items.
- Save energy by using the outside clothes line.

HOT WATER ENERGY SAVERS

- Do as much household cleaning as possible with cold water. When washing dishes by hand, use a sink stopper or a dishpan and run the hot water as little as possible. Rinse your dishes in cold water.
- Adjust your water heater's temperature to prevent unnecessary operation. Although many units are set at 140 ° F at the factory, you may find that 120 ° F is satisfactory for your family's needs. However, if your dishwasher does not have an internal heating element that can raise the temperature to 140 ° F, a 120 ° F setting is not recommended. Many new water heaters have a "vacation" setting; use it when you're away for more than a few days.

- Turn the thermostat “down” or “off” when you’re on a vacation of three days or more.
- Consider using a shower head with a shut-off valve.
- For baths, close the drain in the tub before turning on the hot water; the temperature can be adjusted later as the tub fills.

ENERGY-SAVING EXTRAS

Tank insulation

You can increase your energy savings by adding insulation to the water tank. Fiberglass water-heater blankets, available at local building supply outlets, can be used to wrap the tank. Be sure to follow the manufacturer’s safety instructions on installation, especially if you have a gas water heater. In addition, do not insulate close to heater flues as they carry hot combustion gases.

Heat trap

The heat trap is a fairly inexpensive device that can be added to a water heater. A loop of tubing mounted between the tank and the pipes, this device reduces the unwanted convective circulation (see “Helpful Terms”) of heated water in the pipes when water is not being used. Heat traps are available for a few dollars at plumbing supply stores and can be installed by a do-it-yourselfer. The heat-trap savings are modest, but should result in energy savings sufficient to pay for the initial heat trap cost in two to three months.

CHAPTER 3

MAJOR OPPORTUNITIES

MAJOR APPLIANCES

Most homes contain dozens of appliances, from essential ones like stoves, refrigerators, and heating and cooling equipment, to convenience extras like food processors and deep fryers. And while an individual appliance may be a relatively small contributor to your home energy costs, choosing an energy-efficient model can save you money over time, even if the initial cost is more than the cost of a standard model.

This section describes what to look for in an energy-efficient appliance, how to determine the cost of an appliance over its life and how to estimate the annual cost of using the appliances in your home.

SELECTING ENERGY-EFFICIENT APPLIANCES

When it's time to purchase new appliances, either for your new home or to replace existing equipment, buy the most energy-efficient appliances you can afford.

There are several considerations in choosing an energy-efficient appliance. Understanding efficiency ratings; where to find them; and how they affect the purchase price and energy costs over the life of an appliance are all important considerations. Also, knowing which appliances use the most energy and how to estimate the energy costs for specific appliances in your house can be useful in comparison shopping.

APPLIANCE EFFICIENCY STANDARDS

The California and federal governments have standards which establish minimum operating efficiencies for major appliances. These standards assure consumers that any appliance covered by these standards meets a *minimum* level of efficiency. However, it is easy to purchase more efficient appliances than the standards require, and that will provide you with savings on your monthly utility bill.

Information regarding appliance efficiencies is available on federal EnergyGuide labels and from the California Energy Commission's appliance directories.

ENERGYGUIDE LABELS

Look for the yellow and black EnergyGuide labels when shopping for major appliances. Most EnergyGuide labels show the yearly energy cost of operating an appliance. These labels help you to compare the energy costs of competing brands and models of a similar size with similar features. When considered along with the purchase price, the label will help determine which appliance is less expensive to own and operate over its life. This process, called life-cycle cost analysis, is explained in this fact sheet.

EnergyGuide labels are required on furnaces, refrigerators and refrigerator/freezers, freezers, water heaters, clothes washers, dishwashers, room and central air conditioners and heat pumps. Combined, these nine major appliances consume more than 75 percent of the energy in California homes.

To shop for the best buy on labeled appliances, familiarize yourself with three types of EnergyGuide labels: energy cost, energy efficiency ratio and generic.

ENERGY COST LABELS

Energy cost labels are used on refrigerators and refrigerator/freezers, freezers, water heaters, dishwashers and clothes washers (see Figure 4). The large number in the center of the label is the estimated *annual cost* of the energy required to operate the appliance, based on a national average electricity rate. The bar beneath it shows the range of operating costs of competing brands and models of similar size and features. Therefore, you will quickly be able to see how the model you are considering compares to others. When possible, you should *choose the model with the lowest annual operating cost.*

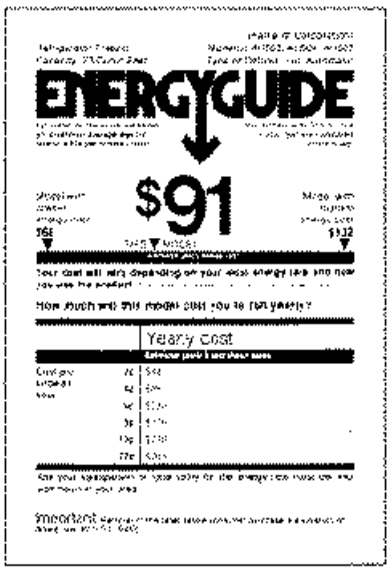


Figure 4:
Energy Cost Label

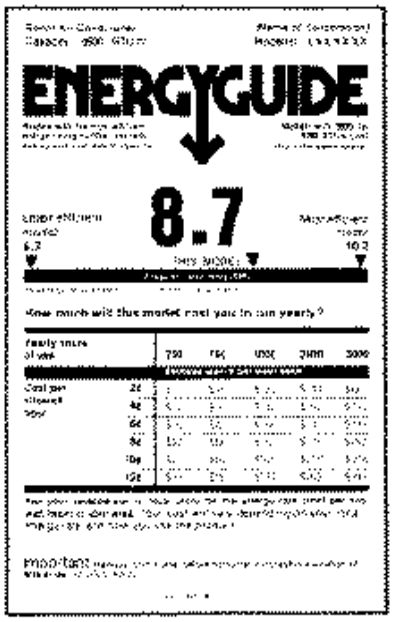


Figure 5:
Energy-Efficiency Ratio Label

At the bottom of the label is a chart that allows you to determine more precisely what the cost will be to operate the appliance based on your local utility rate. If you do not know your local gas or electricity rates, you can calculate them by using the method described under "Calculating Energy Costs." Energy cost labels for dishwashers and clothes washers also include a chart indicating the cost of running the appliance with either a gas or electric water heater.

ENERGY-EFFICIENCY RATIO LABELS

Room air conditioners are labeled with an energy efficiency ratio (EER). The EER does not factor in performance over the cooling season.

The rating is printed in large numbers in the center of the label. *A higher number indicates a more efficient appliance.* There also is a range — printed on the bar just below the energy efficiency ratio — for competing equipment of the same cooling capacity to help you make shopping comparisons easily. In addition to the energy efficiency ratio, the label provides a chart so that you can calculate the energy cost of the appliance based on local electricity rates and the expected hours of use.

Air conditioners and the air conditioning cycle of heat pumps must have a minimum seasonal energy efficiency ratio (SEER).

A SEER of at least 8.9 is required for single package (one piece) units. Beginning January 1993, the minimum allowed will be a SEER of 9.7. Split systems, those with an indoor and outdoor component, require a SEER of at least 10.0. The most efficient units have a SEER of 14 or more. Look for a SEER of at least 11 when purchasing a new central air conditioner.

Central heat pumps are required to have a heating seasonal performance factor (HSPF) of 6.6 for single package units and 6.8 for split systems. The top ratings are 9.0 or more. Look for an HSPF of at least 7.5 when purchasing a new heat pump.

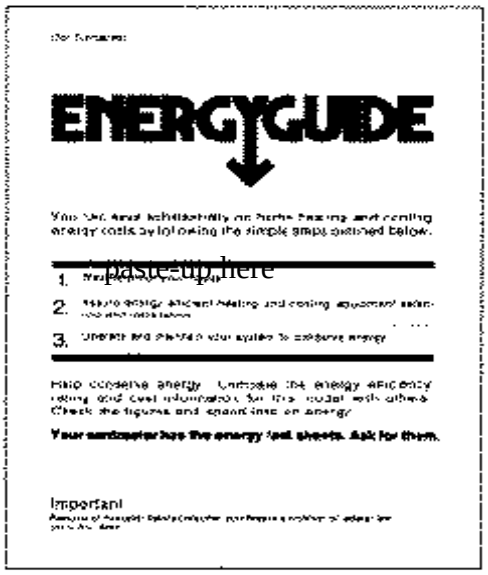


Figure 6:
Generic Label

GENERIC LABELS

The generic label required on all furnaces contains general information on how to conserve energy in the home (Figure 6). It also directs you to an energy fact sheet developed by the manufacturers. The dealer or heating system contractor will have product fact sheets containing information on system components, overall efficiency of different combinations, and energy costs of the system for various geographic locations and utility rates.

Central gas furnaces are required to have an annual fuel utilization efficiency ratio (AFUE) of at least 78 percent. Many models are available with AFUEs in the low 80 percent range. Then there is a jump to models using different technologies with AFUEs above 90 percent. Before purchasing a furnace, check the various technologies available and their associated costs.

LIFE-CYCLE COST

When purchasing an appliance, the two major costs to consider are the purchase price and the operating cost. Over its life, a major appliance will consume hundreds, perhaps thousands, of dollars in electricity or gas. When buying a major appliance, shop for long-term value. The purchase price of an appliance—such as a refrigerator — may be relatively small compared to its lifetime operating cost. Paying a little more for the energy-efficient model can earn you high returns over the life of the appliance.

Life-cycle cost analysis allows you to determine which appliance is most economical over its lifetime (right). As an example, let's compare two refrigerators, each having the same capacity and features, but with different purchase prices ($500 and $400) and operating costs ($70 and $120 per year).

First, look at the Average Life Expectancy Table (right) to see how many years you are likely to pay the yearly energy cost for a refrigerator. Use 14 years as indicated in the table. Multiply 14 times $70 to find that operating Model A for 14 years would cost $980. Added to the purchase price of $500, the life-cycle cost would be $1480.

To operate Model B for 14 years would cost $1680 (14 times $120/year). Added to the purchase price of $400, the life-cycle cost would be $2080. Although Model A would cost more initially, over 14 years it would save you $600 in overall or life cycle costs.(See table top right.)

Many utilities offer rebates to help with the purchase price of higher efficiency appliances. Check with your local utility for rebates before purchasing any major appliance. High-efficiency appliances may cost more initially so a rebate makes the high efficiency model much more affordable, especially when considering life-cycle cost.

APPLIANCE LIFE EXPECTANCY

Well-maintained appliances may easily exceed the average life expectancies listed in the table (middle right). Instructions provided with appliances explain maintenance and operation and should be followed closely to realize the maximum energy savings and life expectancy.

RESIDENTIAL ENERGY USE

The energy use pie chart shows how the average household in California uses energy. Furnace, heat pump and room and central air conditioner use

LIFE-CYCLE COST ANALYSIS

	Model A	Model B
Gas Purchase Price	$500	$400
Yearly Operating Cost	$70	$120
Lifetime	14years	14years
Lifetime Operating Cost	$980	$1680
LIFE-CYCLE COST	$1480	$2080

Table 1.

AVERAGE LIFE EXPECTANCY TABLE

Appliance	Life (Years)
Central Air Conditioners	12
Clothes Dryers	13
Clothes Washers	12
Dishwashers	12
Freezers	21
Gas Furnaces	18
Heat Pumps	12
Ranges and Ovens	18
Refrigerators	14
Room Air Conditioners	11
Water Heaters	13

Table 2.

ENERGY USE – RESIDENTIAL BUILDINGS

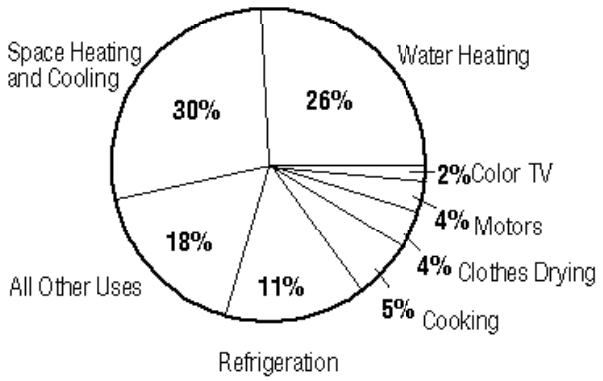


Figure 7.

ACTION:

You can get more information about the energy costs of your appliances by doing some detective work. Examine your appliances to find out their wattage or Btu/ hour rating.

is included in Space Heating and Cooling on the chart. Refrigerators, refrigerator/ freezers and freezers are grouped together under Refrigeration. Water heaters and the energy consumed to heat water for clothes washers and dishwashers is included in Water Heating. Other appliances are listed separately or included under All Other Uses. Lighting accounts for about one-half of All Other Uses.

While improving the efficiency of all energy-using appliances is important, the chart can help concentrate your efforts on appliances using the most energy in your home. You probably use energy differently from the statewide averages in the chart. Lifestyle, number of people living in your household, hours of operation, the efficiency of specific appliances and climate are major reasons for variations in these percentages.

Cooling is probably the most variable of these percentages. In California, many areas do not require mechanical cooling in the home. However, if you live in an area with hot summers, such as the central valley of California, energy use for cooling may be nearly as much as heating.

The most important factors affecting the variability in heating and cooling energy include:

- Local climate conditions
- Landscaping around the house
- Efficiency of the heating and cooling equipment
- Thermal characteristics of the house (insulation, caulking, window area, orientation of the house, etc.)
- Living habits of the occupants (i.e., how warm or cool you maintain your home and the number of hours you are at home each day)

Living habits, the last item in the list, affect the energy use of *all* appliances. For example, leaving the thermostat set at 70°F, rather than reducing it to 60°F while everyone is at work or school, increases heating energy use by 10 to 15 percent. A setback thermostat can make lowering the temperature a convenient habit. For example, it can be set to automatically turn the furnace "down" after you leave in the morning and to automatically turn the furnace "up" before you return in the afternoon.

CALCULATING ENERGY COSTS

ELECTRIC APPLIANCES

The costs of operating your electric appliances are determined by:

- Wattage
- Hours used
- Cost of electricity

To determine the cost of operating a specific electric appliance, first determine the kilowatt-hours (kWh) used. To do this, multiply the appliance's wattage (shown on the appliance) by the number (or fraction) of hours you use the appliance; then divide that number by 1000:

$$\text{kWh} = \frac{\text{wattage} \times \text{hours}}{1000}$$

For example, a 200-watt color television set used for six hours each day would use 1.2 kWh per day. (200 watts times 6 hours divided by 1000, equals 1.2 kWh.)

Next, from your latest electric bill determine the current cost of electricity. Divide your total electric bill by the total number of kWh used. This figure is your cost per kWh.

For example: $\frac{\$72.00}{800\ \text{kWh}} = \$0.09/\text{kWh}$

Finally, multiply the kWh by your current cost of electricity to obtain the operating cost of the appliance.

kWh x cost of electricity = operating cost

Thus, if you are paying $0.09/kWh, running the television for six hours per day would cost 10.8 cents (1.2 kWh times $0.09/kWh equals 10.8 cents.) For a 30-day month the television would add $3.24 to your electric bill.

Appliance Ratings and Estimated Use

Electric Appliances

APPLIANCE	WATTAGE RATINGS (WATTS)	ESTIMATED USE
Kitchen		
Broiler	1400	1 hour weekly
Clock	2	continuous
Coffee Maker/Automatic		
Brew Cycle	860	Twice daily
Warm Cycle	80	1 hour daily
Coffee Maker/Drip		
Brew Cycle	1500	Twice daily
Warm Cycle	70	1 hour daily
Convection Oven	1600	1 hour daily
Dishwasher (with heater)	1300	Once daily
Food Freezer		
16 cu. ft. manual defrost	350	100 kWh/month
16 cu. ft. auto defrost	450	15 kWh/month
Hot Plate (two elements)	1250	2 hours/month
Microwave Oven	1500	30 min. daily
Range (surface units & oven)	12,000	3 times daily
Self-cleaning process		Once per month
Refrigerator Single Door		
12 cu. ft. manual defrost	120	50 kWh/month
12 cu. ft. auto defrost	180	66 kWh/month
Refrigerator/Freezer		
Frost Free		
14 cu. ft.	300	131 kWh/month
19 cu. ft.	430	188 kWh/month
Utility/Laundry		
Clothes Dryer	5000	20 loads/month (45 minutes/load)
Iron (hand)	1100	4 hours/month
Vacuum Cleaner	600	4 hours/month
Washer (automatic) (does not include cost to heat water)	500	20 loads/month (45 minutes/load)

Electric Appliances

APPLIANCE	WATTAGE RATINGS (WATTS)	ESTIMATED USE
Living Room		
Light Bulbs/Incandescent		
100 Watts	100	6 hours daily
60 Watts	60	6 hours daily
Light Bulbs/Fluorescent		
40 Watt bulb with ballast	50	6 hours daily
15 Watt bulb with ballast	18	6 hours daily
Television		
Black/White	55	6 hours daily
Color	200	6 hours daily
Air Conditioner		
Room	900-1320	400 hours/
Central 3 tons	4200	cooling season
" 6 tons	8200	
Attic Fan	375	6 hours daily/ cooling season
Window Fan	200	3 hours daily (5 months/year)
Water Heater (Quick Recovery)	4500	350 gallons/ month/person

Gas Appliances

APPLIANCE	TYPICAL RATINGS (Btu/HOUR)	ESTIMATED USE
Clothes Dryer	22,000	20 loads/month (45 minutes/load)
Range	30,000	1 hour daily
Outside Grill	35,000	5 hours/week (5 months/year)
Water Heater	40,000	350 gallons/ month/person

Table 3.

GAS APPLIANCES

The costs of operating your gas appliances are determined by:

- Btu/hour rating
- Hours Used
- Cost per therm

To determine the cost of operating a specific gas burning appliance, the first step is to determine the number of therms used. Multiply the appliance's Btu/hour rating (shown on the appliance) by the number (or fraction) of hours you use the appliance; then divide by 100,000.

$$\text{Therms} = \frac{\text{Btu/hour} \times \text{hours}}{100{,}000}$$

The result will be the number of therms used for that period of time. Multiply the therms used by the current cost of gas per therm. To determine your current gas costs, check your utility bill. Divide the total gas bill by the total gas use, listed in therms. The result is the cost per therm.

Finally, multiply the therms by the cost per therm to obtain the operating cost of the appliance.

Use the previous chart to estimate the average cost of using various appliances if you cannot find the energy rating for a specific appliance or if you cannot estimate its monthly usage time. Remember, even though many appliances are always plugged in, very few run constantly.

A GRAIN OF SALT

Don't be misled by names as you start your search. Names like "Energy Miser," "Energy Saver" and "Fuel Saver" don't necessarily guarantee savings. The best way to determine energy efficiency of appliances is to actually compare information provided on the EnergyGuide labels.

TIPS FOR SELECTING ENERGY-EFFICIENT APPLIANCES

Before buying new appliances, call your utility to find out if rebates are available for purchasing high-efficiency models. When shopping, ask your salesperson to show you how to use the EnergyGuide label to compute the payback time for energy-efficient appliances. The following information will also help in your purchase decision.

Refrigerators and freezers.

- A side-by-side refrigerator/freezer typically uses about 35 percent more energy than a model with the freezer on top.
- Chest freezers are usually more efficient than upright freezers. Chest freezers are better insulated and cold air doesn't spill out when the door is opened.
- Automatic defrost freezers can consume 40 percent more electricity than similar manual defrost models.
- Don't buy a refrigerator that is oversized for your needs.
- Get rid of the energy-hogging second refrigerator in the garage.
- One large refrigerator is cheaper to run than two small ones.
- If you move an old refrigerator (more than 10 years old) into your new house, consider getting a new, efficient model.

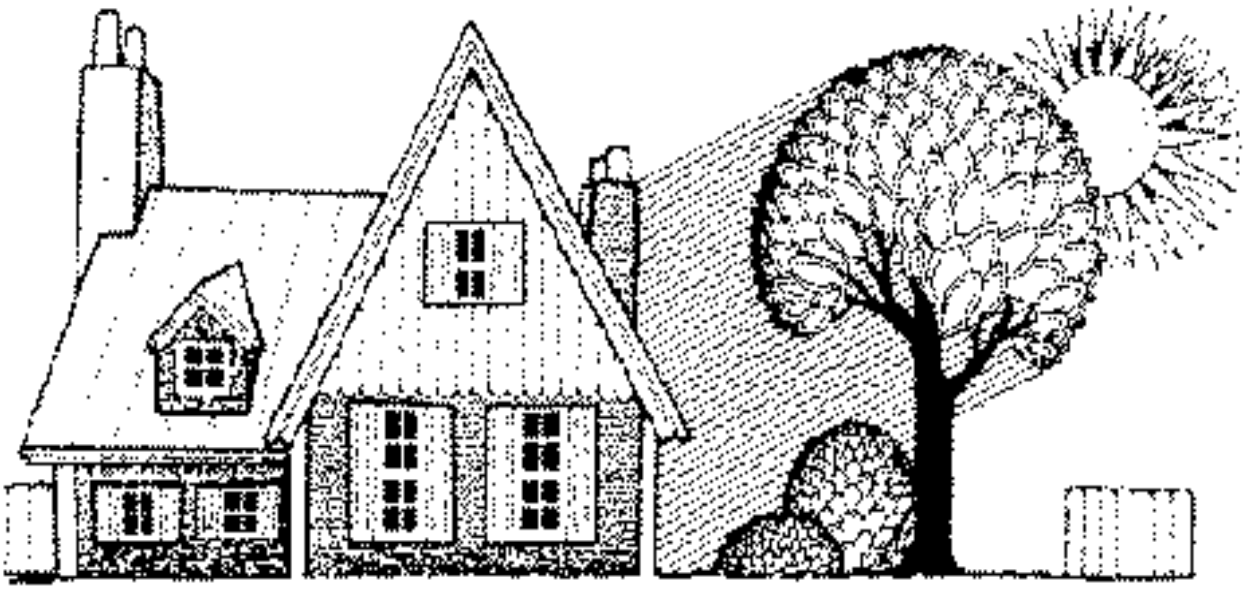
Clothes washers and dryers

- Select a washer that allows control of water level and temperature.
- Select a dryer with these energy-efficient features: moisture sensor control, cool-down cycle and an electric ignition for gas dryers.
- Gas dryers are generally more energy efficient than electric clothes dryers.

Dishwashers

- Select a dishwasher with a booster heater. A booster heater raises incoming water to 140°F or higher. The higher temperature is needed to melt dishwasher soap and clean greasy dishes. A booster heater allows the home water heater to be set to 120°F.
- Look for an energy-efficient model with air power and/or overnight dry settings. These features can save up to 10 percent of your dishwashing energy costs.

Figure 8.
Shading with Trees.



West wall shaded by tree/hedge combination.

LANDSCAPING

Your new home includes many built-in energy efficient features. One major opportunity to make your home even more comfortable is to landscape properly. Decisions made now will affect your energy use for years to come.

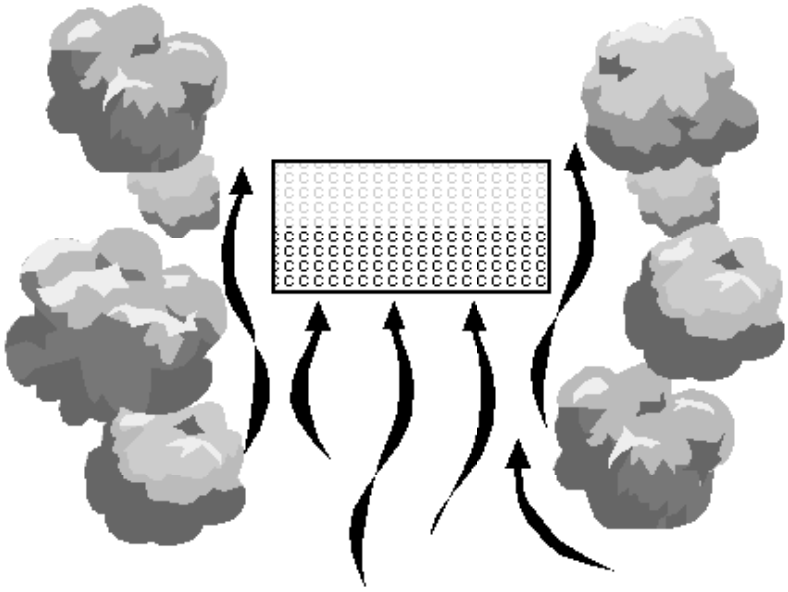
Landscaping can provide an effective, natural way to moderate heat loss and heat gain in your home and help reduce cooling and heating bills. Trees, shrubs, vines, and groundcovers can help keep your home cooler in the summer and warmer in the winter. When planted properly, plants are as beneficial as other energy-saving devices such as insulation or weather-stripping. A deciduous shade tree can provide shade for portions of both roof and walls and, upon maturity, reduce cooling costs up to 20-40 percent and still allow solar heat gain in the winter when the leaves fall. In addition, air drawn into the house from shaded areas will be relatively cooler. Shrubbery planted a few feet away from the house will provide extra shade without obstructing air currents. (Refer to Figure 8.)

Trees and/or shrubs can be planted to shade the air conditioner for more efficient operation. Some trees and shrubs can be used as natural windbreaks to cut down on your heating costs. A wind baffle composed of trees and shrubs is desirable during all seasons, but is especially useful for augmenting natural ventilation during the summer. (See Figure 9.)

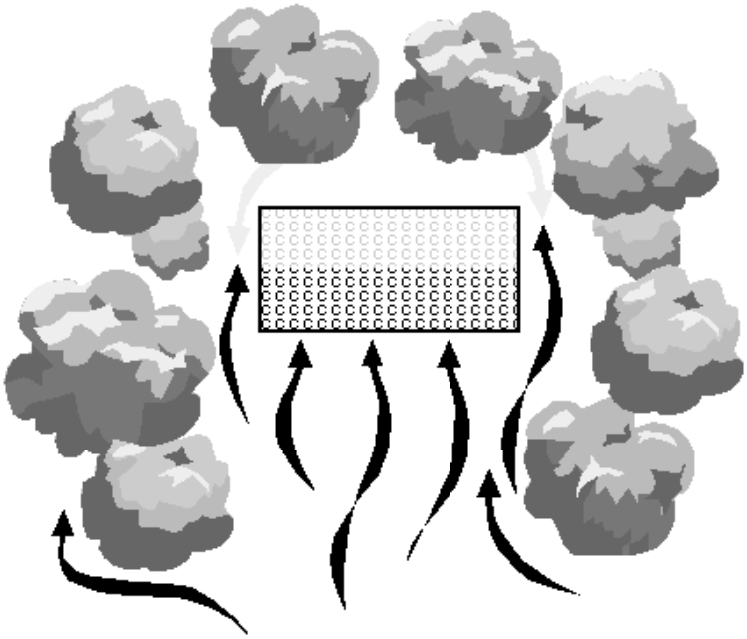
Landscaping is not an alternative to weatherizing your house, but an additional way to help lower your energy consumption and costs. The amount of money saved depends on your home's location and type, and on wind and weather conditions.

Figure 9.
Trees Used to Funnel Breezes.

Trees can be used to funnel breezes to the structure.



Solid pockets of trees deflect breezes and prevent good cross ventilation.



REMODELING

Should you decide to remodel or purchase new energy-efficient equipment, please consider the following information. Remember, all new additions must meet current energy standards. Check with your local building department for the latest requirements.

INSULATION

If you decide to add insulation to your home, observe the following cautions. Most types of insulation require safety concerns. Some fire retardant chemicals and glass and mineral fibers may cause skin irritation, so wear protective clothing such as a long-sleeved shirt, long pants, shoes, gloves and goggles. Wear a dust mask or a respirator to avoid breathing in small fibers.

Wear a hard hat to avoid injuring your head in closed spaces or where nails are protruding, as in an attic. When working above a single ceiling, use boards or plywood to stand on. Don't risk stepping on or falling through the sheetrock ceiling.

If you must install attic insulation during warm weather, try to do it during the coolest part of the day to avoid heat exhaustion. When you begin insulating, be careful not to lift or pull wires. As wiring ages, the wire's insulation may become brittle and damage to the wire may cause electrical shock or fire.

GLAZING

Should you decide to upgrade or remodel, you should take a conscientious approach in selecting new windows. Examine new technologies in glazing. The type of product will depend on whether heating or cooling is your highest cost. If heating is your biggest concern, consider multiple panes and/or low-E glass. If you live in a warm climate or have large glass areas facing west, consider glazing with a low-shading coefficient.

The style and type of frames around your windows is important and affects your home's energy efficiency. Window frames are made of wood, metal, vinyl or some combination of these. Since frames can have such an effect on the thermal performance of a window, the type of frame installed plays a critical role.

Wood and vinyl frames tend to perform better than aluminum frames without a thermal break design. Wood, however, tends to deteriorate due to weathering and must be painted at regular intervals. Vinyl-clad wood frames blend the higher insulating value of wood with the low-maintenance features of vinyl. Vinyl window frames are durable, virtually maintenance free and share similar thermal characteristics with wood. Metal conducts heat and is a poor insulator. Aluminum, the most commonly used metal framing material, transfers heat faster than wood and has little insulating value unless the window has a thermal break design.

Careful consideration of windows and window frames can result in substantially increased efficiencies, comfort and utility bill savings in winter and summer.

- **Storm windows** are transparent, require no daily maintenance and may be less expensive than commercially produced "movable insulation." An even less expensive variation is the interior storm window consisting of a clear, plastic film sealed tightly around the edge of the window frame.
- **Movable insulation** refers to a variety of products and techniques used in the winter to reduce heat loss through windows. A conventional home can lose from 20-50 percent of its heat through the windows. During winter nights, homes with large amounts of window glass are particularly vulnerable to heat loss.

Most persons favor interior window insulation because it is protected from the weather; easy to reach; inexpensive and does not affect the home's appearance from the outside.

Since traditional interior curtains, drapes and exterior shutters are primarily decorative furnishings, the window insulation that replaces or supplements them needs to be aesthetically acceptable. This need is compounded because rooms with the greatest need for movable insulation are often the most frequently used areas of your home. Thus, the movable insulation's effect on your home's appearance should be a major consideration when choosing a system.

Examples of interior movable insulation include thermal curtains and shades. Exterior movable insulation includes thermal shutters, exterior hinged and sliding shutters and exterior roll shutters.

- **Solar screens** reduce the amount of sunlight reaching windows and reduces the need for air conditioning. Solar window screens are especially effective on the home's east and west sides and on south-facing windows with inadequate overhangs. Contact your utility for information on possible rebates.
- **Reflective films** are another method of controlling the balance of heat gain and heat loss through windows. These films reflect sunlight away from the window or reflect heat back into the room. Care should be taken to select high quality films and make sure they are properly installed.

STORM DOORS

In areas of California with severe winters, storm doors are essential. When well-fitted, they provide an airspace between indoor and outdoor air. The doors should be well constructed, weatherstripped and caulked.

FIREPLACES

Tubular grates

Tubular grates can nearly double the efficiency of a fireplace. These grates use convection or forced air to move heat into the room. Those using electric fans to move air are generally more efficient than those without fans. The thick-walled pipe should be inspected periodically for holes that may develop.

Metal fireplace inserts

Stove-like double wall inserts can be installed in your existing fireplace. These are equipped with tight-fitting glass or metal doors, a vent that pulls combustion air in from outside, and built-in fans. These inserts can raise the efficiency of your fireplace and are useful if you use your fireplace a great deal.

Heat circulators

You may also choose to install one of the many available air and heat-circulating fireplace liners. This option is particularly advantageous if your fireplace is on an exterior wall and losing valuable heat to the outside. This does not eliminate the need for a direct fresh air supply.

HEAT PUMPS

By replacing your electric furnace with a high-efficiency heat pump, you can increase your energy savings and reduce your heating bills. In thinking about buying a heat pump, you should consider climate; price and availability of fuels; price of electricity; initial cost of the system and reliability. Look for utility-sponsored rebates for purchasing energy-efficient heat pumps, then consult a knowledgeable dealer or engineer who can recommend the best size and system for your situation.

GAS FURNACE

Sizing a replacement furnace correctly requires professional assistance from your heating contractor. If you have added extra insulation, weather-stripping and other efficiency measures since installing your original furnace, you may be able to use a smaller replacement unit. If you are unsure about the correct size of a replacement unit, have the heating contractor analyze your home to determine the correct size.

When a gas heating system wears out, select a new system with the highest affordable efficiency. Two features that improve the efficiencies of systems are the vent damper and the electronic pilot ignition. New technologies such as scroll compressors and pulse furnaces allow much higher efficiencies. Check for information on energy efficiency and cost of operation. You can find this manufacturer-provided information on the yellow and black EnergyGuide label attached to the unit. (Please see "Major Appliances" in this chapter for information on how to read EnergyGuide labels.)

GAS SPACE HEATERS

Space heaters are used to heat smaller areas or individual rooms. A practical use would be to install one in an addition to your home, such as a den or family room. The newest models of gas space heaters are insulated so the top and sides are cool to the touch.

WHEN PURCHASING A NEW AIR CONDITIONER

If you shop for a new air conditioner, first consider whether central air conditioning or room air conditioning will suit your needs better. Central air conditioners generally provide the greatest comfort but cost more than room units.

If several rooms need to be cooled, a central system is probably the best buy. If different areas of the house have different cooling needs, consider a zoned system as described in Chapter 1. When choosing between units with similar prices, capacities and features, energy efficiency should be the deciding factor.

ENERGY MANAGEMENT SYSTEMS

The newest strategy in home energy management is based on microprocessors and thermistor sensors. Considering the many functions these new home energy managers control, they are surprisingly price competitive with automatic thermostats.

The objective of any thermostat is to increase furnace efficiency by regulating its on-off cycle. The new programmable thermostats "learn" and "remember" your living patterns and slow down the wasteful cycling of the heating/cooling system when not needed—overnight, on weekends, or when no one is home. By keeping the highest temperature up for five hours a day, for example, rather than 16 hours a day, these micro-electric models can quickly pay for themselves.

REPLACING DUCT WORK

At some future point you may suspect that your heater isn't working properly and, upon inspection, discover the problem is actually deteriorated duct tape rather than your heating equipment. Indeed, duct work is an important factor in energy efficiency, and air leakage to and from ducts will offset any savings expected from your well-insulated home.

As the adhesive on the cloth "duct tape" or similar product originally used to seal your ducts may not provide an airtight seal over the life of your home, you should inspect it periodically to make sure ducts are properly sealed.

Supply ducts carry conditioned air from the heating and cooling equipment to the house and the return ducts carry room air back to the equipment. Your local hardware store will assist you in selecting duct sealant. The seams of all of your duct work must be sealed in both return and supply ducts with a high temperature tape, mastic or other suitable material. Traditional "duct tape" has a short life and should be avoided in any search for replacement sealant.

FANS

Because of increasing energy costs, natural cooling techniques are regaining popularity in California. These techniques can both reduce total cooling energy and shorten the time when air conditioning is required. To use natural cooling techniques effectively, first employ good energy use practices year round, such as turning off unnecessary lights and appliances, caulking, weather-stripping and insulating walls and ceilings. Then you should also open your windows to take advantage of cooling breezes that may occur naturally in your area. All of these measures reduce unwanted internal heat gain that causes discomfort during the summer.

Fans can enhance natural ventilation cooling. Two types of fans commonly used in homes today are ceiling fans and whole house fans.

Ceiling fans

Ceiling fans have made a comeback. Ceiling fans can provide comfort at roughly the same temperature levels as a whole-house fan (see following whole house fan discussion). Unlike the whole-house fan, however, ceiling fans do not draw in air from the outside; instead they circulate air within the room. As air moves across your body, a wind-chill factor makes you feel cooler.

Ceiling fans can be used effectively with or without the air conditioning in operation. The primary benefit of the ceiling fan is that it allows you to raise the thermostat setting 4 to 6 ° F higher and still maintain a level of comfort because of the circulating air.

On the average, a ceiling fan uses about the same amount of electricity as a 100-watt light bulb. You can run one for 10 hours for about 8 cents. If the ceiling fan ran for 10 hours each day for a month, the energy cost would be $2.40.

Whole-house fans

Whole-house fans are used in place of air conditioning when outside temperatures and humidity levels are comfortable and only when the outdoor air temperature is sufficiently cooler than the indoor temperature. This is why a whole-house fan can be an especially effective cooling technique at night. At times of poor outdoor air quality, use of the whole-house fan should be restricted.

For the whole-house fan to function effectively, windows must be opened in rooms where the air is to enter and the attic must have proper outlets to exhaust the air. The fan should not run at the same time as the air conditioner.

Whole-house fan care

Whole-house fans do not require regular professional maintenance, but seasonal maintenance is a good idea. Simple maintenance consists of the following steps:

- Turn off the power at the circuit breaker box
- Check the fan's belt drive and adjust tension if it is slack
- Check the shutters' action and oil the fan if necessary
- If a fan's motor housing has oil ports (and there are no lubricating instructions to the contrary), oil the motor bearings once a season with a few drops of SAE 20 oil

ENERGY-SAVING PUMP MOTORS

If your future plans include a new pool or spa, or replacement of the old pump, buy an energy saving, high-efficiency motor. Energy-saving pump motors reduce operating costs and save electricity.

SOLAR WATER HEATERS

If you are thinking about buying a solar domestic hot water system, before you buy, find out what your potential savings will be. Private firms or your local utility company can audit your home to determine how present energy costs can be reduced and whether a system would be cost-effective. If you decide to install a system, investigate several options before deciding which type is best for your site. A well-made, properly maintained system should last 15 to 20 years, which means your decision will have long-lasting results. Talk to solar professionals — energy consultants, builders, contractors, designers and home heating suppliers — for guidance.

LIGHTING

Choose energy efficient fixtures if you remodel your home or just decide to change the lights. It is possible to install fluorescent fixtures that produce lighting quality virtually identical to that of incandescent fixtures; they also use much less energy for the same amount of light.

Past problems of poor color rendition and humming ballasts have been solved, making new fluorescent fixtures a good choice.

You may want to install recessed lighting fixtures. All incandescent lighting fixtures recessed into insulated ceilings must be approved for zero-clearance insulation cover (I.C.). When these new fixtures are installed, cover them with insulation to prevent heat loss or gain through the fixtures. Recessed fluorescent fixtures are available that can have insulation installed right over the fixture.

Financial Incentives for Saving Energy

Your new house has an efficient heating and air conditioning system, adequate insulation, better windows, energy-saving appliances and fewer cracks through which air can escape. Investing in greater energy efficiency will provide even greater payoffs. Recent studies show a greater demand for homes that consume energy wisely. As energy prices rise, the demand for such homes increases, as does the value of your property. In addition to financial advantages, an energy-efficient house is a more comfortable and relaxing place to live. Refer to Figure 10 to learn where your energy dollars go.

Making energy-saving improvements to your home is a wise investment. In addition, you may be able to offset the cost of longer-term energy efficiency improvements on your home with any or all of the following financial incentives:

- Your utility company may offer special rebates or low-interest loan programs. To find out how to qualify and what the current list of rebate and financing levels are, call your local utility.
- Manufacturers of efficient appliances and products frequently offer rebates.
- Your lender may allow you to finance energy efficiency investments when refinancing your current mortgage or when you purchase another home. Ask your lender, for example, for information on an "energy efficient mortgage." This financing tool allows home owners to roll the cost of energy improvements into their mortgages and to amortize the cost of the improvements over the life of the mortgage.

Know Where Your Energy Dollar Goes

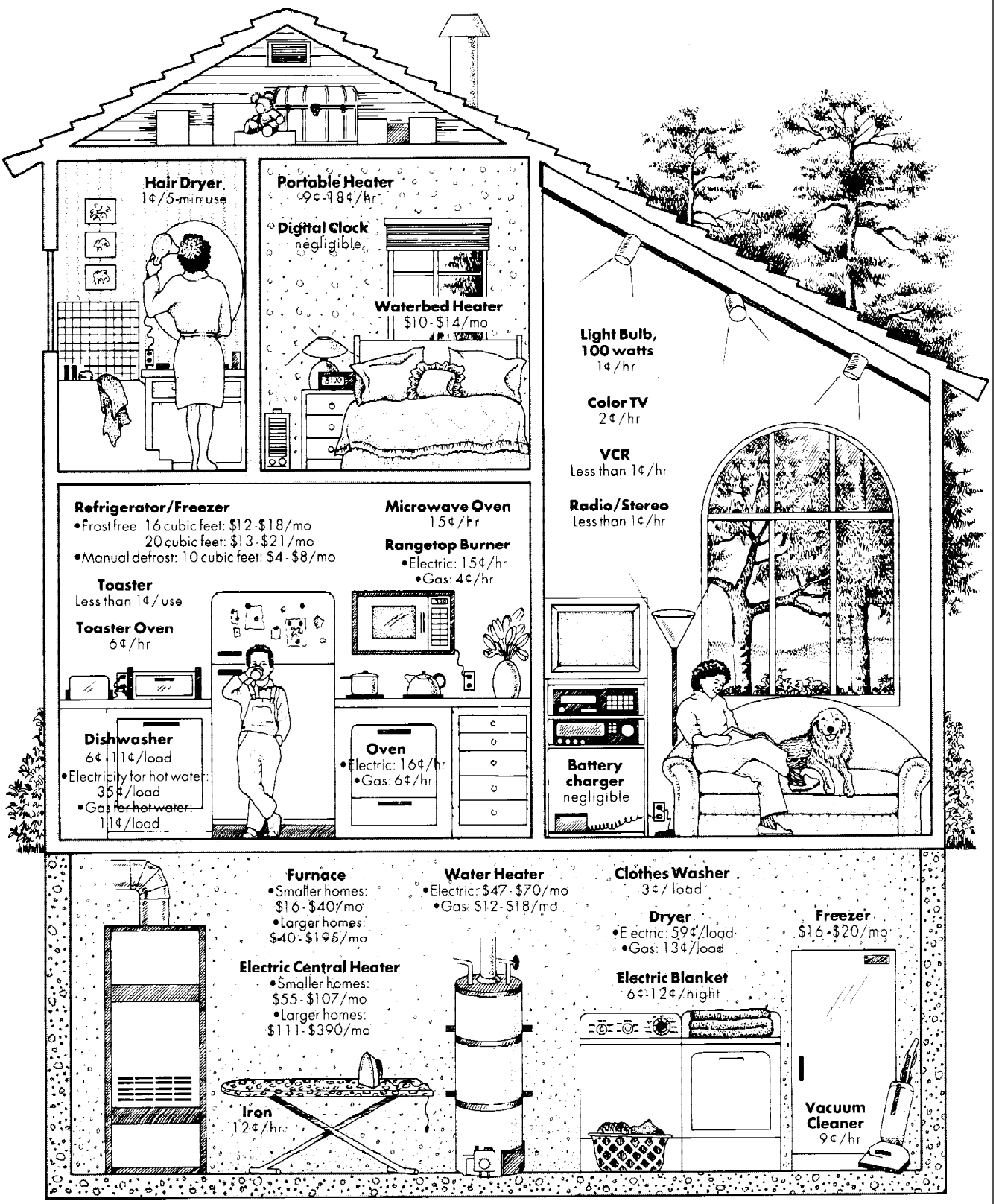


Figure 10.

Courtesy of PG&E; drawing from *PG&E Progress*, Feb. 1991

CHAPTER 4

HOME ENERGY EFFICIENCY STANDARDS

For a house to comply with California's energy efficiency standards, two basic requirements must be met:

- Installation of several mandatory measures representing minimum efficiency features and devices
- Demonstration that the home's predicted annual energy use meets the designated energy budget for space heating and cooling and for water heating.

Mandatory measures include minimum ceiling, wall and raised floor insulation levels; minimum heating, air conditioning and water heating equipment efficiencies; infiltration controls and other features described in Chapter 1. These mandatory measures are required in all new homes. A list of these requirements is included at the end of this chapter.

"Variable" features such as shading, window types, window glazing areas and thermal mass — also described in Chapter 1 — are features that may already be installed in your home. These features, in addition to mandatory measures, were installed to demonstrate compliance with the energy standards using one of the methods described. To check which mandatory measures should be in your house, look at the applicable measures on the sample MF-1R form at the end of this chapter.

To discover which energy-saving features were installed in your home to supplement the mandatory measures, look at the completed Certificate of Compliance form (CF-1R) at the end of the manual.

COMPLIANCE WITH THE ENERGY BUDGET

Your home's builder had a choice of methods to show compliance with energy efficiency goals, depending on location (by climate zone) of your home:

PRESCRIPTIVE PACKAGES

This approach is the simplest and least flexible compliance path. There are five prescriptive packages for each climate zone in the state. Each package is based on a different construction strategy:

A: Passive solar
B: Tight building envelope
C: All electric
D: Conventional slab floor
E: Conventional raised floor

There is no flexibility within any given package: Every single feature must be met in order for your home to comply.

POINT SYSTEM

The point system allows builders to make trade-offs between different home conservation features. In this compliance approach, points are assigned to conservation measures: positive (+) points for features or levels of performance that reduce annual energy use and negative (-) points for measures that increase annual energy use. Your home is in compliance if the sum of all points equals or exceeds zero.

COMPUTER METHODS

This method provides the greatest flexibility to demonstrate compliance. The approved computer method generates an energy budget for the hot water and space conditioning needs of your house. This budget is derived by modeling your proposed home, assuming all the prescriptive Package D or Package E features.

HOW YOUR HOME COMPLIED WITH HOME ENERGY STANDARDS

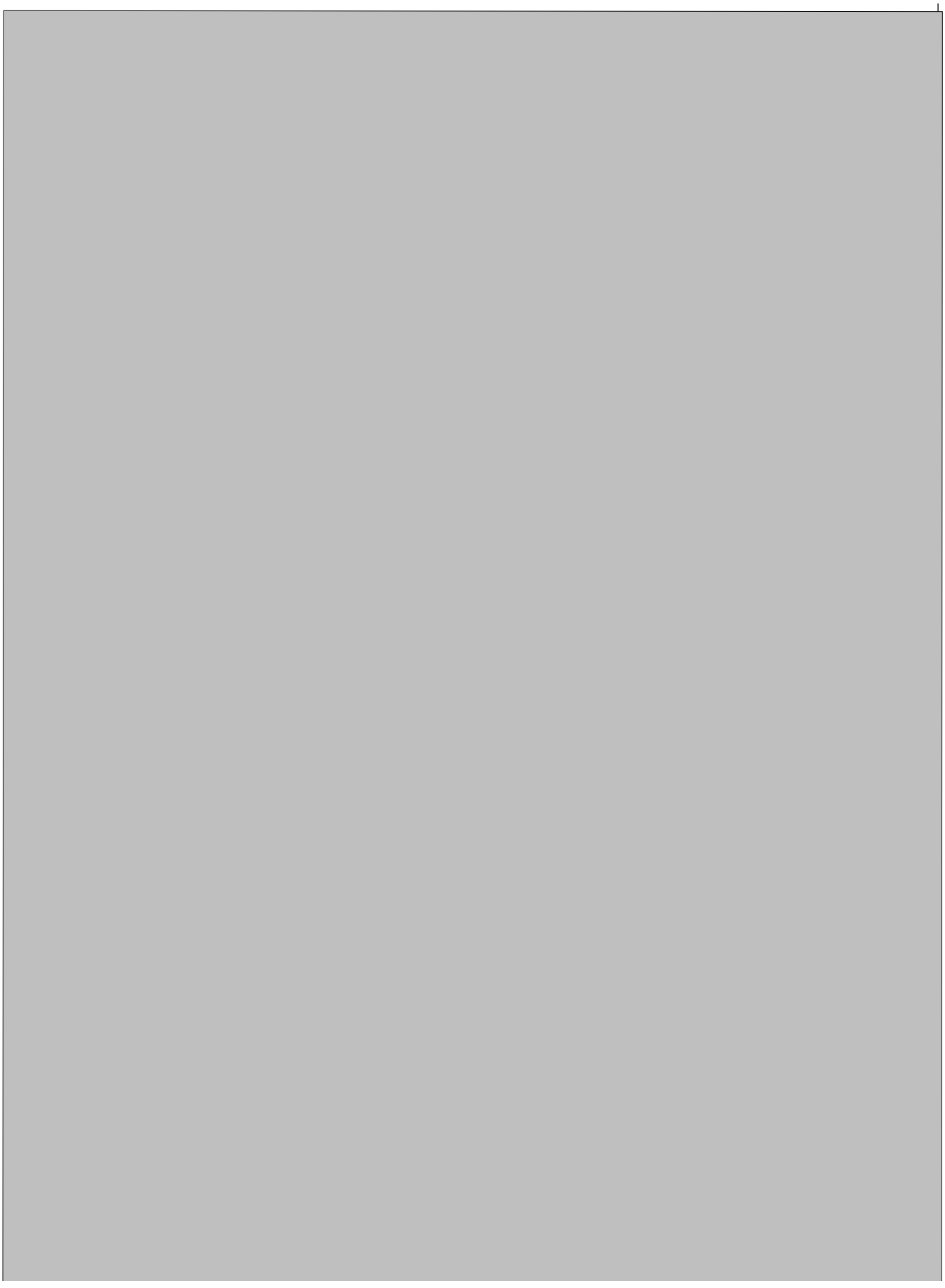
Regardless of the compliance method used, all new homes must meet or exceed minimum levels established by the California Energy Commission and incorporated in the state building code. Such mandatory measures also establish installation criteria and material specifications for new homes, additions to homes, and remodels made in conjunction with such add-ons. (Refer to the MF-1R form at the end of this section.)

Compliance with energy standards required your builder to:

- Verify that the correct climate zone was used for your home's location based on the 16 climate zones established by the California Energy Commission. Energy use depends partly upon differing weather conditions throughout the state.
- Show that your home meets the standards with one of the three compliance approaches: prescriptive, point or computer.
- Include all appropriate mandatory features and provisions applicable to your home's design.
- Complete the Certificate of Compliance (CF-1R) form and attach it to the drawings for your home.
- Install all specified measures in your home listed on the Installation Certificate (CF-6R) — also provided upon purchase of your new home.

The items listed in your CF-1R form represent a set of minimum energy performance specifications. While a point-system or computer-method analysis may be used to show compliance of a particular combination of measures, your home must be constructed to meet or exceed the performance level established by all of the features and specifications contained in your CF-1R form.

Retain the CF-1R form and give it at time of sale to your home's future buyers.



CHAPTER 5

RESOURCES

WHY THE CALIFORNIA ENERGY COMMISSION HAS PROVIDED THIS MANUAL

The California Energy Commission is California's principal energy-planning agency. Its programs are among the nation's most innovative and successful. The Energy Commission's goal in preparing this manual is to help you operate your home in the most energy-efficient manner, for the most comfortable and affordable home possible.

Beginning in 1978, energy efficiency standards were established in response to a state mandate to reduce California's growth in energy demand. For the home owner, the reduction in energy costs due to the standards means a significant reduction in the cost of operating a home.

COMMISSION HOTLINE

The Energy Commission operates an Energy Hotline. If you have specific questions about the energy standards, compliance with the standards or other energy-related areas, call toll-free Monday through Friday, 8 a.m.-noon and 1-3 p.m. at 1-800-772-3300. If located outside California, please call 916-654-5106.

COMMISSION PUBLICATIONS OFFICE

A catalog of the Energy Commission's publications and information on various energy-related topics is available free of charge from the California Energy Commission's Publication Office.

To request your publications catalog please call 916-654-5106. If you know the publications you wish to receive and their costs, send your orders to:

California Energy Commission
Publications Office, MS-13
P.O. Box 944295
Sacramento, CA 94244-2950

Please enclose a check or money order, payable to the California Energy Commission, to cover costs.

REFERENCE PHONE NUMBERS:

Contractor/Builder
Name:_____
Phone:_____

Electrician:
Name:_____
Phone:_____

Heating and Cooling Contractor:
Name:_____
Phone:_____

Local Utility(ies):
Name:_____
Phone:_____
Name:_____
Phone:_____

Real Estate Agent:
Name:_____
Phone:_____

Others:
Name:_____
Phone:_____

Name:_____
Phone:_____

HELPFUL TERMS

Here are explanations of a few handy terms to help you use the manual.

A.F.U.E. : Annual Fuel Utilization Efficiency is a measure of heating efficiency used for furnaces and boilers. AFUE represents the ratio of the heat transferred to the conditioned space to the fuel supplied over one year.

Btu (British thermal unit): This is a measure of heat. The size or capacity of air conditioners, furnaces, and water heaters are measured in Btus.

Conditioned Space: Enclosed space either directly or indirectly heated or mechanically cooled.

Conduction: Heat passing directly through a material. (See R-value and U-Value.)

Convection: Flow of heat energy by movement of a fluid, such as air or water, caused by a temperature difference.

Decorative Gas Appliance: A gas appliance designed or installed for visual effect only; cannot burn wood and simulates a fire in a fireplace.

EER (Energy Efficiency Ratio): The ratio of cooling capacity in Btuh (British thermal units per hour), at rated conditions, divided by the electrical input in watts. The higher the EER, the more efficient the unit. (See also SEER below).

Footing: The weight of your house rests upon the foundation. The foundation consists of footing — a large mass of concrete poured into a trench — and the foundation wall, which rests on the footing.

Fossil Fuels: Oil, coal or natural gas fuel formed in the earth in prehistoric times from remains of living organisms.

Gas Log: A self-contained, free-standing, open-flame, gas-burning appliance consisting of a metal frame or base supporting simulated logs and designed for installation only in a vented fireplace.

Glazing Materials: Transparent or translucent (glass, plastic, plastic films, coated glass) used for admitting solar energy and light into the house.

R-value: A measure of the resistance of a material to heat conduction. High R-values provide greater resistance to the flow of heat and increased energy efficiency. (See Conduction and U-Value.)

Radiation: Radiation occurs when warm objects dissipate their heat directly to cooler objects. Thus, a person standing near a cold window will feel chilled as the warm body radiates heat to the colder window.

SEER (Seasonal Energy Efficiency Ratio): The total cooling of a central air conditioner in Btu, during its normal annual usage period for cooling, divided by the total electric energy input in watt-hours during the same period. The higher the SEER, the more efficient the unit.

Shading Coefficient: The ratio of the solar heat gain admitted through glazing with particular shading devices to the solar gain admitted through an unshaded single pane of 1/8" double strength clear glass. The smaller the SC, the better shading it provides.

Unconditioned Space: A space neither directly nor indirectly heated or mechanically cooled such as the garage, which can be isolated from conditioned space by partitions or closeable doors.

U-Value: The ability of a material to conduct heat. The reciprocal of R-value (R-value = 1/U value). The lower the U-value, the greater the thermal resistance provided.